INTERAVIA

REVIEW OF WORLD AVIATION

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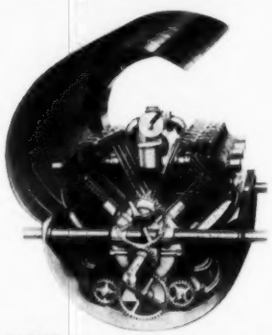
20th PARIS AIRCRAFT SHOW

VOLUME VIII 6 1953

FIAT
Aviation

45 years of technical progress

From the first aircraft engine (1908)
to the G. 80 jet aircraft

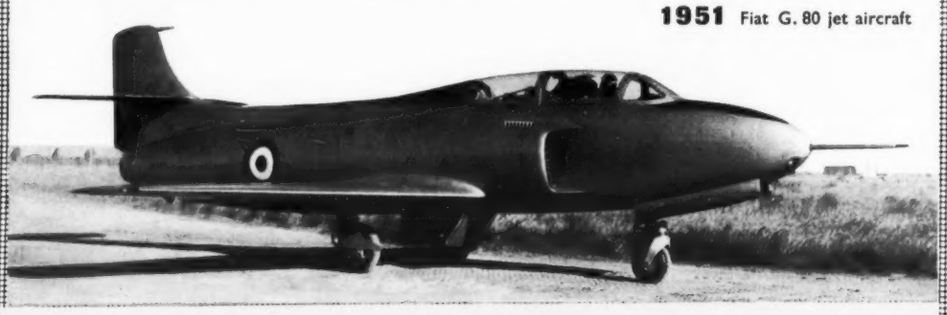


1908 Fiat's first aircraft engine

aircraft

engines

propellers



1951 Fiat G. 80 jet aircraft

FIAT - Direzione Aviazione - Corso IV Novembre 300 - Turin (Italy)

INTERAVIA

Review of World Aviation

Volume VIII — No 6 — 1953

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Front cover

Deluc's painting of a "domenical aerial fun fair" at Juvisy airfield, near Paris, in 1909. (see "... We cannot legitimately be absent ...")

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THIRD INTERNATIONAL TECHNICAL EXHIBITION

TURIN September 30th - October 11th 1953

International exhibition of technical progress, illustrating machinery, work, industrial and artistic accomplishment. All branches of mechanical engineering and metallurgy, aeronautical construction, agricultural machinery with practical demonstrations, plastics, cinematography.

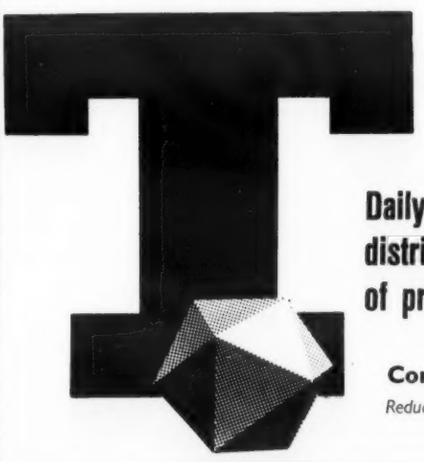
Programme of show

October 1st—2nd: Fifth International Plastics Congress.
October 3rd—5th: International Mechanical Agricultural Days with practical demonstrations at the National Mechanical Agriculture Centre.
October 4th—6th: Fifth International Cinematographical Congress.
October 10th: "Engineering Day".
October 9th—11th: Fifth International Mechanical Production Congress.

October 3rd - 9th:

INTERNATIONAL FILM FESTIVAL

INTERNATIONAL PHOTOGRAPHIC EXHIBITION



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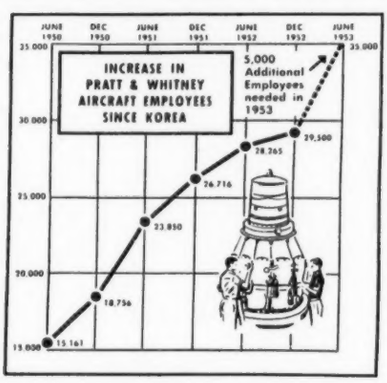
United Airgram

UNITED AIRCRAFT EXPORT CORPORATION

PRATT & WHITNEY AIRCRAFT HIRES 30,000TH EMPLOYEE

Pratt & Whitney Aircraft division of United Aircraft Corporation recently hired its 30,000th employee. In a little over two and one half years, since the outbreak of war in Korea, the division has doubled its work force to meet expanded aircraft engine requirements of the U.S. military services and civilian aviation throughout the free world. Increasing production of such engines as the J-57 turbojet, the world's most powerful aircraft power plant being built in quantity, will require the division to add another 5,000 workers to its payroll this year.



Since mid-1950 Pratt & Whitney's factory area also had doubled. Space devoted to manufacturing now totals 4,000,000 square feet in four plants. This space does not include extensive research and development facilities, nor does it include a variety of other engineering, test, and service structures.

Approximately 50 per cent of the total horsepower to be produced by Pratt & Whitney Aircraft will be jet in 1953. The T-34 turboprop and ramjet engine programs are moving ahead, and deliveries of piston engines will be increased during the year.

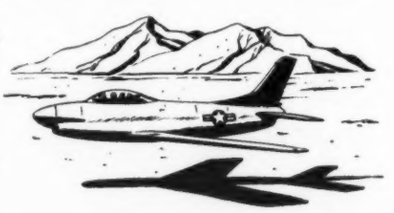
Meanwhile it has been revealed that the company's investment in facilities for its extensive experiment and development work is now four times as much as it was at the end of World War II.

HAMILTON STANDARD PRODUCTS MEET SEVERE TESTS

Hamilton Standard's air cycle refrigeration unit in recent weeks contributed to an outstanding performance record by one of America's top jet fighters, the North American F-86D Sabre.

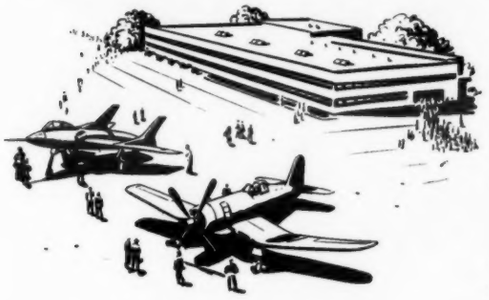
The Sabre, equipped with the Hamilton Standard refrigeration unit, set a new official world speed record of 698.5 miles per hour while flying at an extremely low altitude. Without the cooling unit, temperatures in the cockpit would have risen to unbearable levels largely because of air friction on the skin of the airplane.

High-performance cooling units are essential, since, in a jet flying 600 m.p.h. at sea level, the temperature could rise to 190 ° Fahrenheit in a cockpit not equipped with refrigeration units. Fifty per cent of this heat would be generated by air friction on the aircraft skin, 40 per cent by solar radiation, and 10 per cent by the pilot's body heat and other causes.



PUBLIC INSPECTS CHANCE VOUGHT AIRCRAFT FACTORY

Chance Vought Aircraft opened certain sections of its plant in Dallas, Texas, for public inspection on two days in February. Crowds estimated at more than 50,000 persons attended the two-day "open house," the first Chance Vought has had since this division of United Aircraft Corporation moved to Dallas five years ago.



The event marked the end of production of the famed Chance Vought F4U Corsair fighter planes -- the end of piston-engine fighter aircraft production in the United States -- and the beginning of an all-jet era for the division. The twin-jet, swept-wing F7U-3 Cutlass fighter is now being built for the U.S. Navy.

While new Corsairs will no longer be made, the life of these famed fighter airplanes is far from ended. Seven versions of the airplane including a new heavily armored, heavily armed type designed for ground attack missions, are now in active combat use in Korea. The last group of production Corsairs, designated the F4U-7, were manufactured for the French Navy under the Mutual Defense Assistance Program.

During World War II more than 12,000 Corsairs were built. They destroyed 11 enemy aircraft for each of their own kind lost in air combat. By the end of World War II the gull-winged fighters had fought from the Solomon Islands to the Indian Ocean, from the South China Sea to Norway. They were flown by the U.S. Navy and Marine Corps, by the British, and by the New Zealand Air Force.

SIKORSKY HELICOPTERS SERVE FLOOD VICTIMS, BEGIN FREIGHT SERVICE

In flood-stricken Holland and England, helicopters recently flew from dawn to dusk for days evacuating flood victims and bringing in food, medicines and other supplies to survivors. Thousands of lives were saved by helicopters from American, British and Dutch military units. Taking part were big Sikorsky S-55s from U.S. Air Force units, Dutch S-51s, R.A.F. S-51s and U.S. Army Bell H-13s.

In the United States, big Sikorsky S-55 helicopters are now being flown by New York Airways, Inc. in freight transfer service between LaGuardia, Idlewild and Newark airports in the New York City area. Currently, only air freight from airlines is being carried. However, public air freight service is expected to begin soon. In the operation, freight moving through the New York area can be enormously speeded. For example, four hours is required for surface travel freight between Idlewild International airport, on Long Island, and the Newark airport in New Jersey. But by S-55 helicopters, the transfer between the two points can be made in only 18 minutes.

The new service inaugurated the world's first regularly scheduled civilian helicopter freight operation. Meanwhile, other air carriers, such as the pioneering Los Angeles Airways, Inc., are also expected to institute helifreight services in addition to air mail work. The Los Angeles firm uses both Sikorsky S-55s and S-51s but the big S-55s would be used for air freight hauls.

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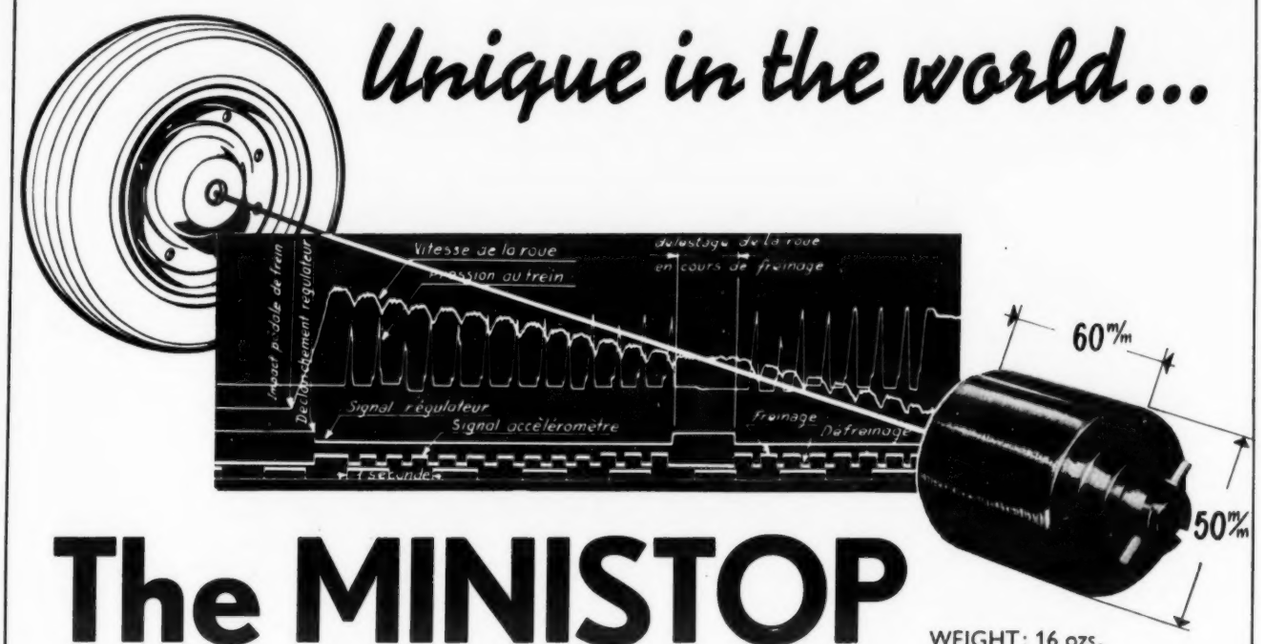

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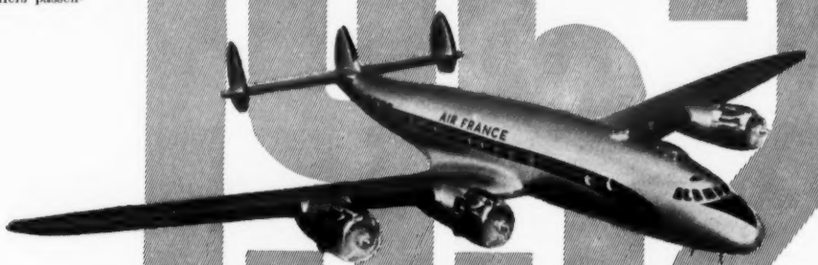
With each succeeding year Air France is consolidating its position on the world market through its constantly expanding route network, its high standard of maintenance, the comfort and service it offers passengers.

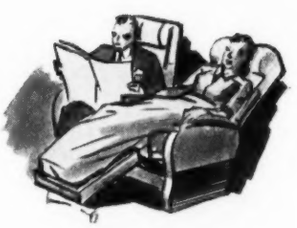
1952



A constructive year, as the following facts show

The opening of several new routes brought Air France's network up to 250,000 kilometres.

APRIL :	Opening of the Paris-Mexico City service.
NOVEMBER :	Paris-Tokyo in 37 hours 30 minutes flying time by "Constellation".
DECEMBER :	Installation of sky lounge chairs on one of the Paris-Casablanca services. New luxury service to Dakar.
JANUARY 1953 :	Air France opened the Paris-Caracas-Bogota service.



Air France is doing its utmost to bring the aircraft within reach of all :

— *"tourist class" has been introduced on some routes.*
— *major reductions have been agreed to on others.*

Air France is constantly improving and modernizing its fleet. During 1952, the famous Lockheed "Constellation", nicknamed the "Atlantic favourite", came into general use on the principal routes.

"Super Constellations", Vickers "Viscounts", de Havilland "Comets" and Bréguet "Deux-Ponts" have been ordered and will be put into service in 1953.

Air France has a powerful organization at your service. Why not make it your first choice among airlines?

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IN BOTH TECHNICAL AND COMMERCIAL FIELDS, AIR FRANCE "QUALITY" IS KNOWN THROUGHOUT THE WORLD

On July 8th, 1952, Mr. Neeland, a representative of the U.S. Civil Aeronautics Administration handed over to Air France the certificate awarded by C.A.A. to the workshops of the Overhaul Centre and Maintenance Service at Orly. Operational Centre. A similar certificate was awarded to the Courbevoie engine overhaul centre in October 1951. Air France is one of the few companies to hold this Civil Aeronautics Administration certificate.

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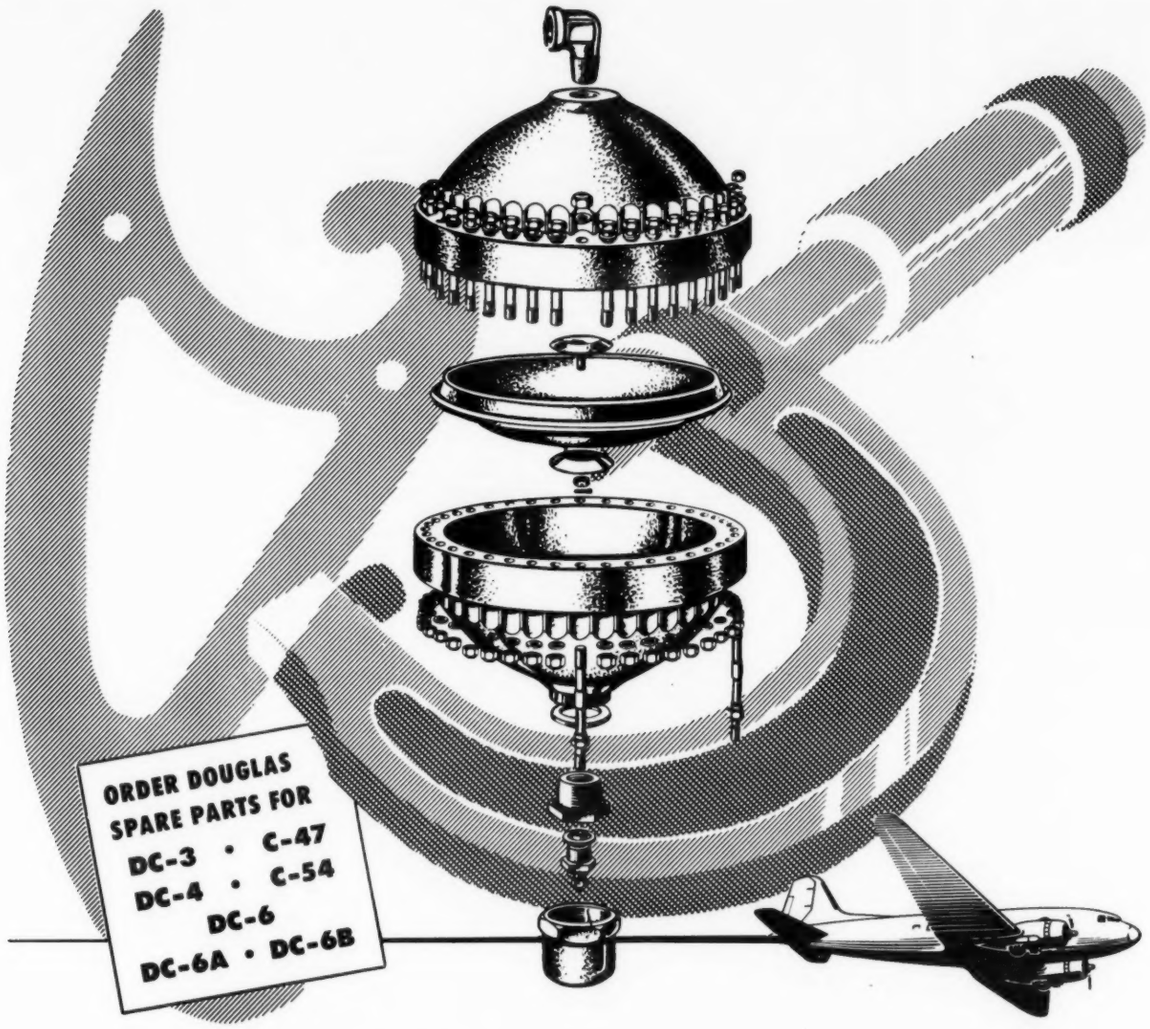

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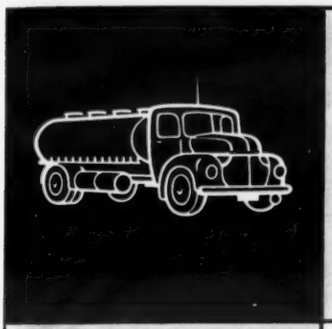

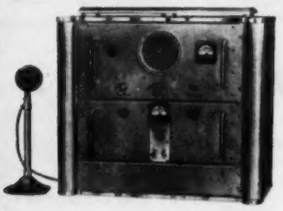

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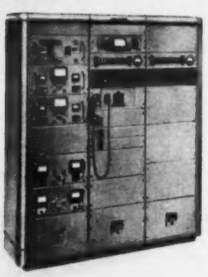

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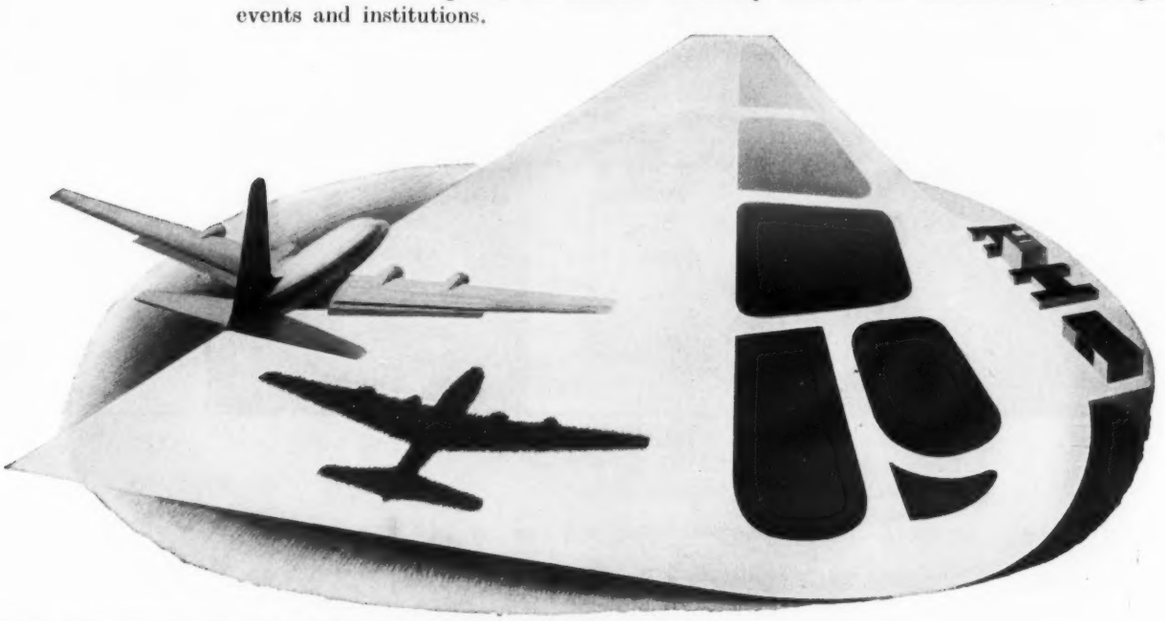

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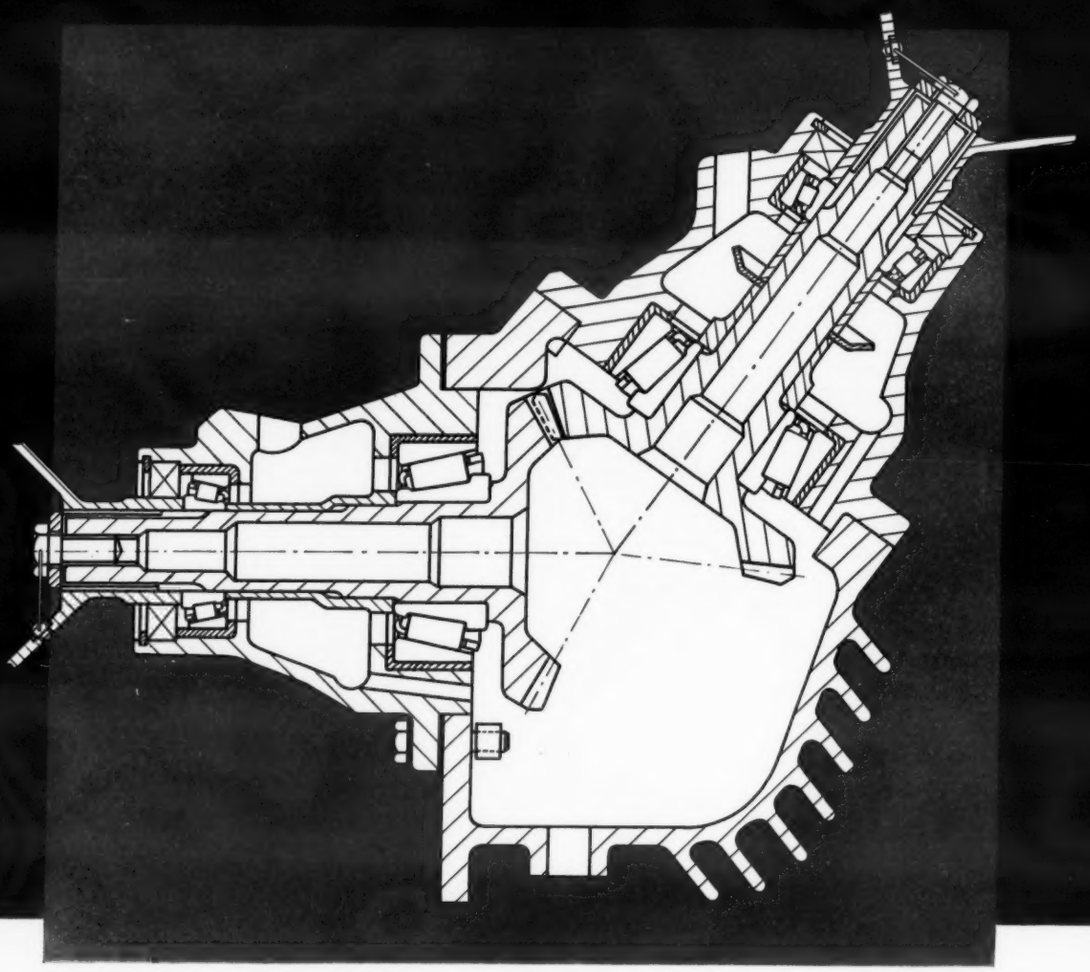
1,325,000 PASSENGER MOVEMENTS IN 1952

CROSS-ROADS OF THE WORLD



On the Westland S 55 Helicopter

The drawing shows the mounting of the Timken tapered-roller bearings to the intermediate gear-box, used to provide the change in angle of the drive to the tail rotor gear-box.

Mounted at the junction of the fuselage and the conical tail structure, the gear-box illustrated is driven from the main gear-box by a shaft running parallel to the fuselage.

The simple layout of Timken bearings has the following combination of advantages.

1. Great 'rigidity' of the shafts, derived from the 'encastré' effect of the long line contact and the 'maximum-stability' method of mounting the bearings, whereby the main journal forces are substantially perpendicular to the rollers.

2. The characteristically Timken capacity for meeting thrust and radial loads simultaneously, resulting in an extremely compact installation.

3. The compactness of Timken tapered-roller bearings, giving a greater load capacity for a given difference between shaft diameter and housing bore.

TIMKEN

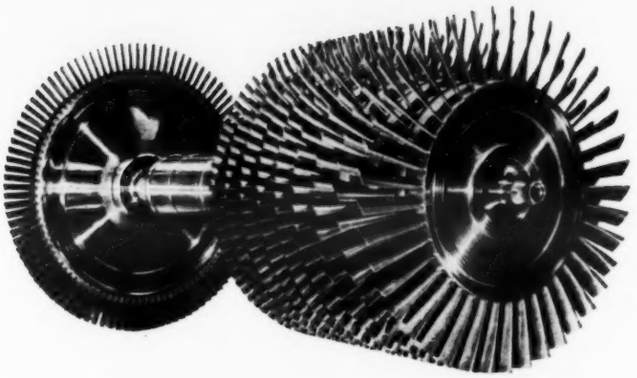
tapered-roller bearings

British Timken Ltd., Duston, Northampton; and Birmingham, England. — Registered Trade Mark: TIMKEN

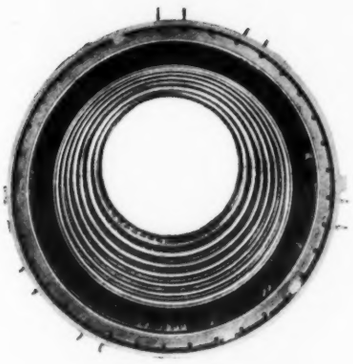
STAL Finspong

THE DOVERN COMPRESSOR ASSEMBLY

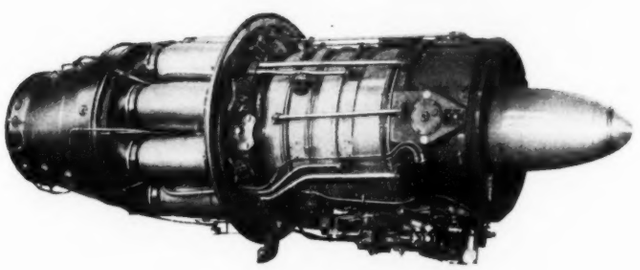
ALL STEEL CASING. . . . . .



ALL STEEL STATOR . . . . . .



ALL STEEL ROTOR . . . . . .



The DOVERN COMPRESSOR is entirely free from mechanical shortcomings and has excellent aerodynamical characteristics.
One of the main reasons for this is its

ALL STEEL DESIGN

STAL is represented at the Paris Air Show by its turbojet DOVERN.

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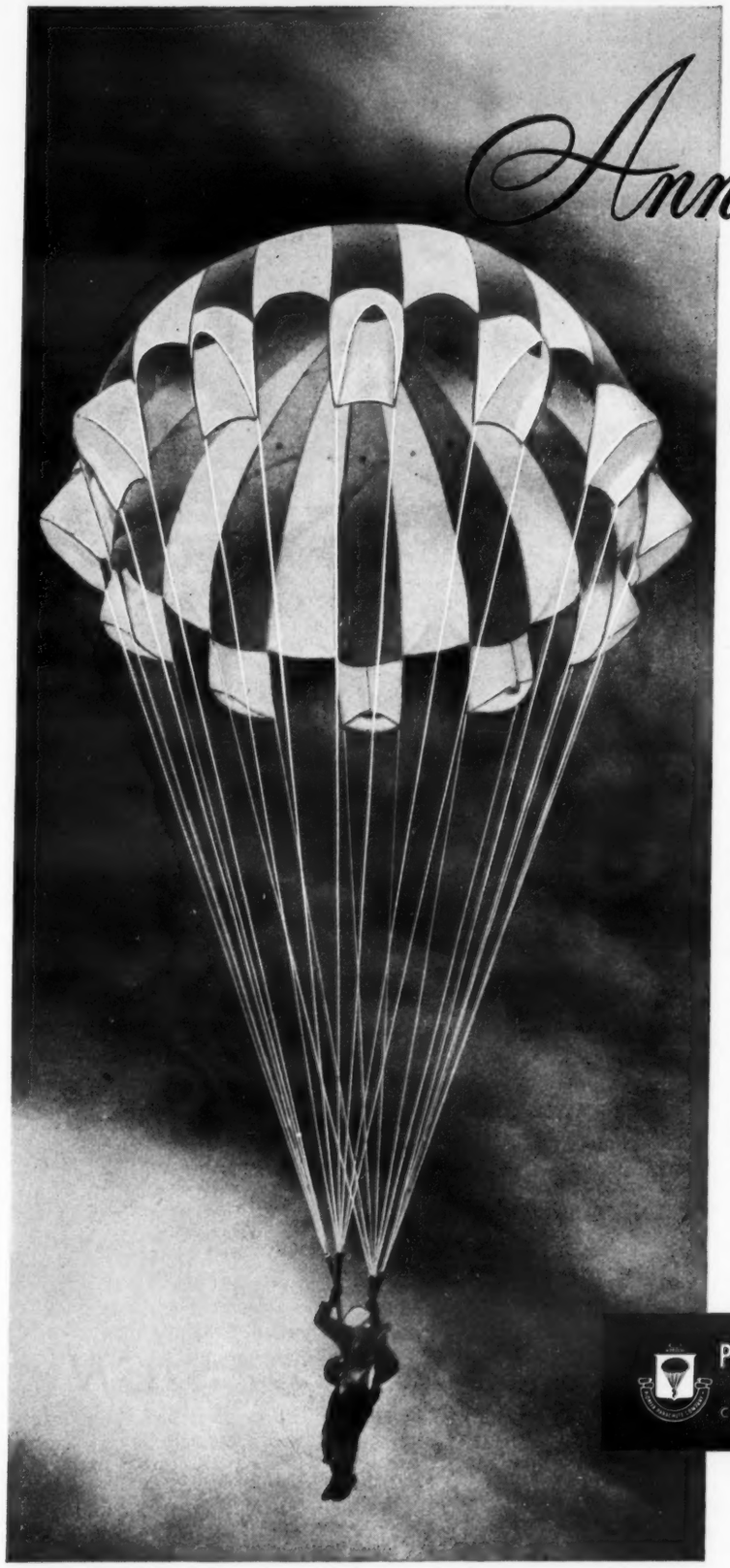

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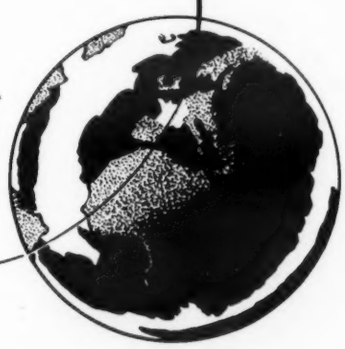

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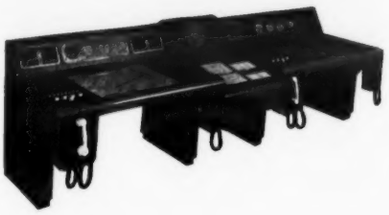

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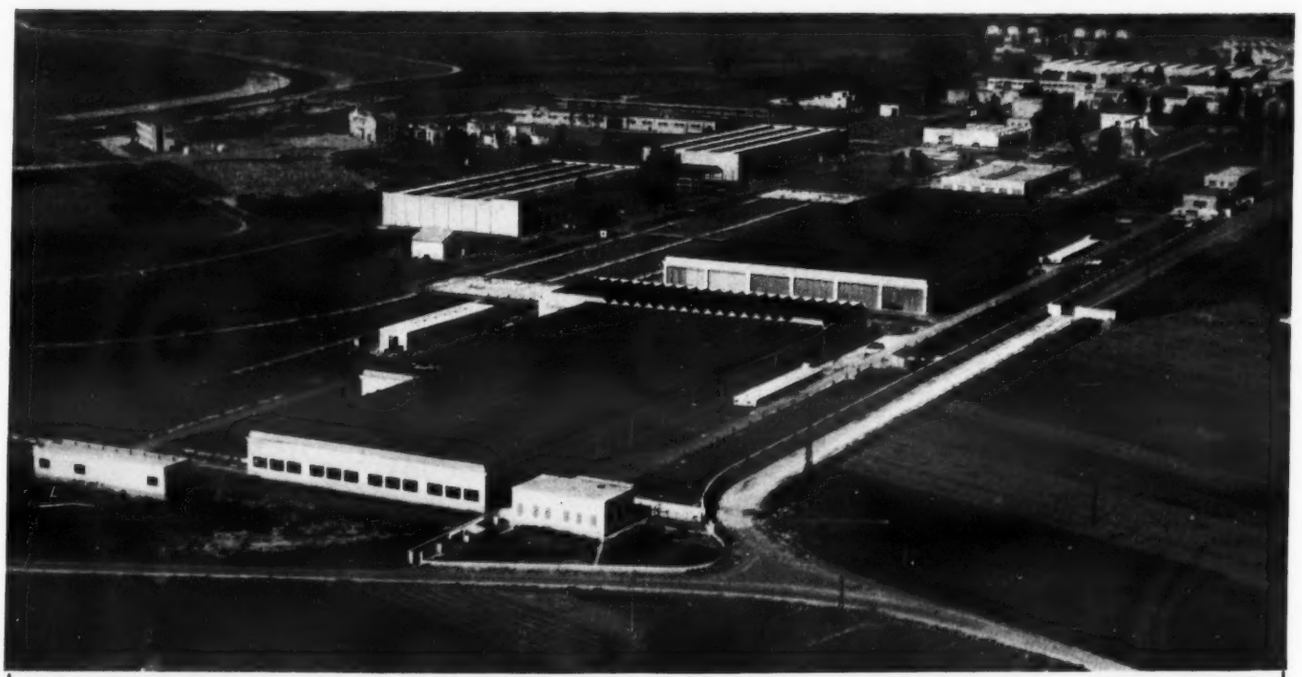

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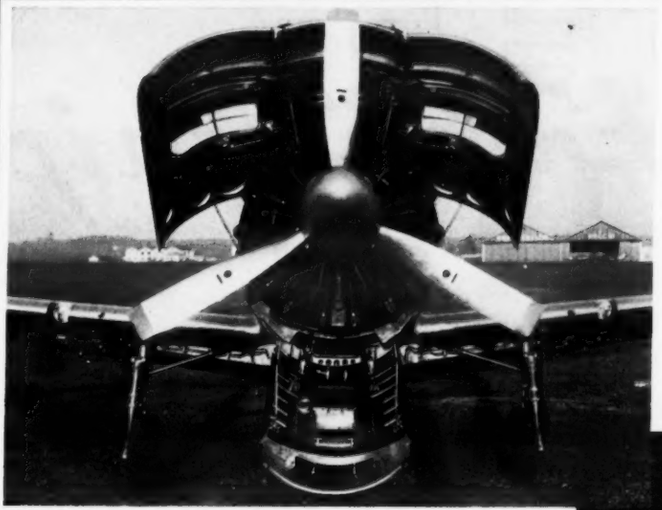

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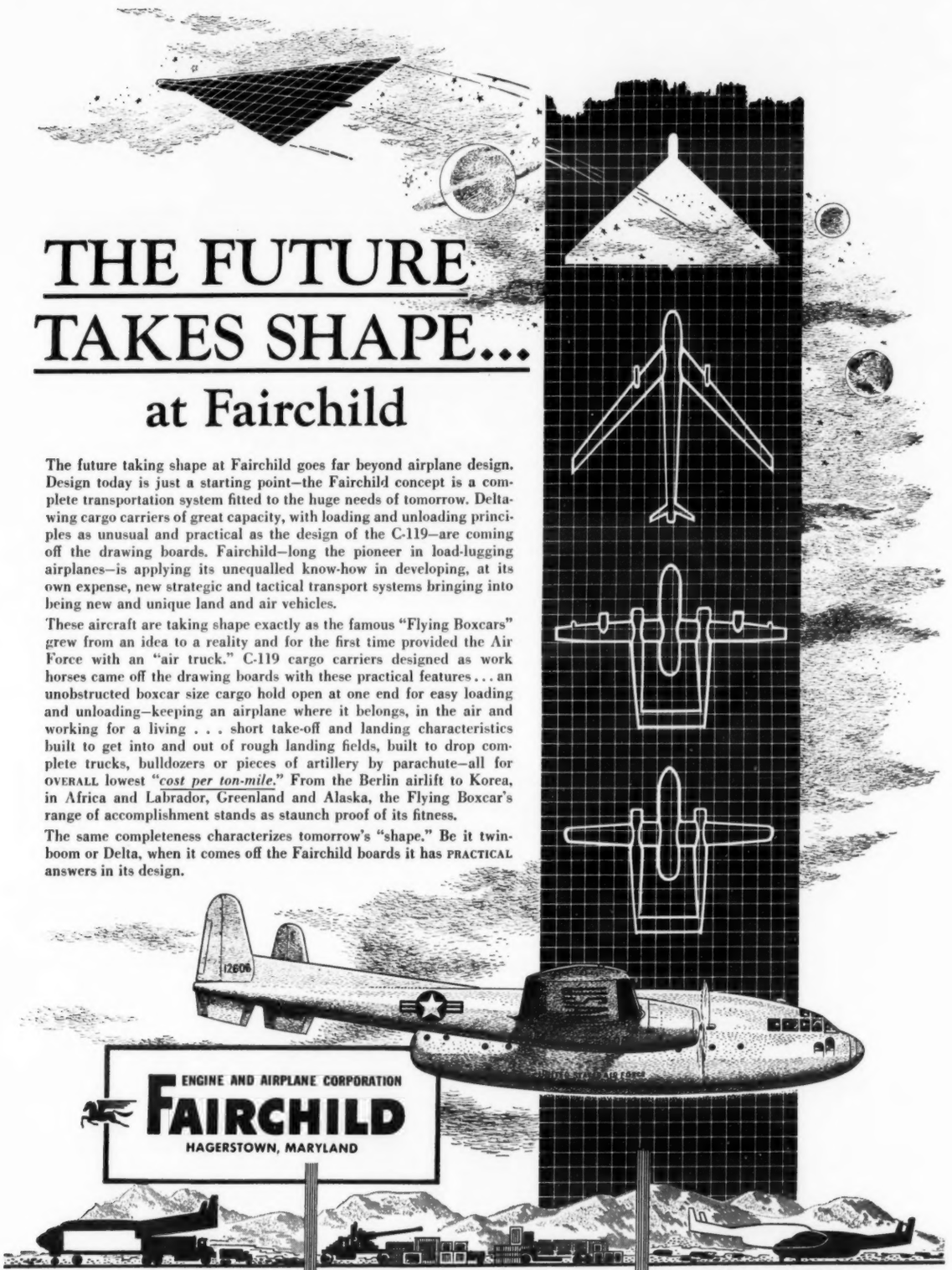

THE FUTURE TAKES SHAPE...

at Fairchild

The future taking shape at Fairchild goes far beyond airplane design. Design today is just a starting point—the Fairchild concept is a complete transportation system fitted to the huge needs of tomorrow. Delta-wing cargo carriers of great capacity, with loading and unloading principles as unusual and practical as the design of the C-119—are coming off the drawing boards. Fairchild—long the pioneer in load-lugging airplanes—is applying its unequalled know-how in developing, at its own expense, new strategic and tactical transport systems bringing into being new and unique land and air vehicles.

These aircraft are taking shape exactly as the famous "Flying Boxcars" grew from an idea to a reality and for the first time provided the Air Force with an "air truck." C-119 cargo carriers designed as work horses came off the drawing boards with these practical features . . . an unobstructed boxcar size cargo hold open at one end for easy loading and unloading—keeping an airplane where it belongs, in the air and working for a living . . . short take-off and landing characteristics built to get into and out of rough landing fields, built to drop complete trucks, bulldozers or pieces of artillery by parachute—all for OVERALL lowest "*cost per ton-mile*." From the Berlin airlift to Korea, in Africa and Labrador, Greenland and Alaska, the Flying Boxcar's range of accomplishment stands as staunch proof of its fitness.

The same completeness characterizes tomorrow's "shape." Be it twin-boom or Delta, when it comes off the Fairchild boards it has PRACTICAL answers in its design.

ENGINE AND AIRPLANE CORPORATION

FAIRCHILD

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EASE OF LOADING — typical of the combat-proven C-119, is basic in the design features of tomorrow's practical and daring Fairchild shapes to come.

ANY TYPE OF MILITARY LOAD will be carried in future Fairchild "shapes"—a feature incorporated as a *must* for future military flexibility.

MINIMUM TURN-AROUND TIME is basic engineering in all "shapes to come" so that mission of the future will have the lowest "*cost per ton-mile*."

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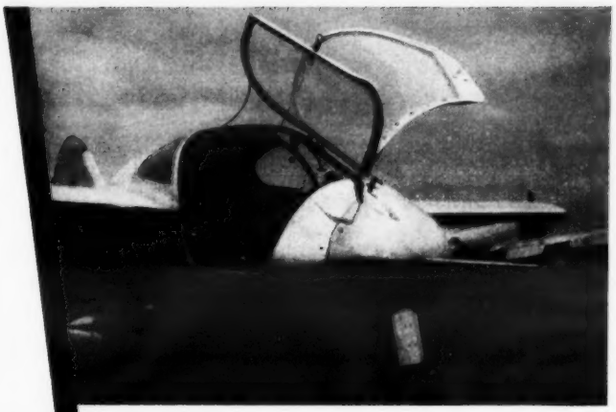

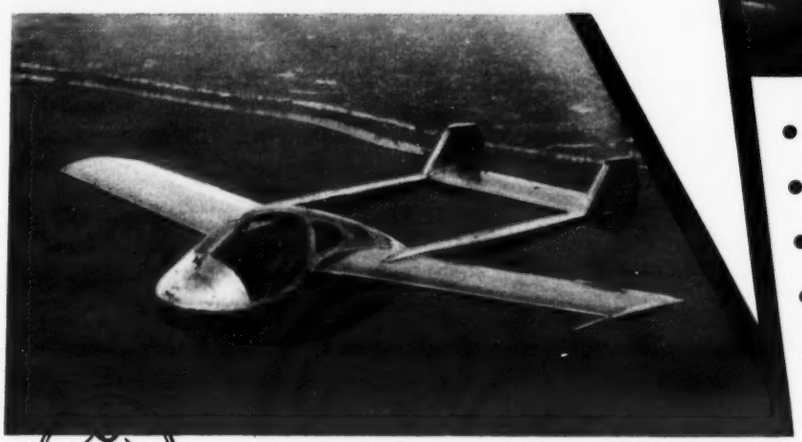

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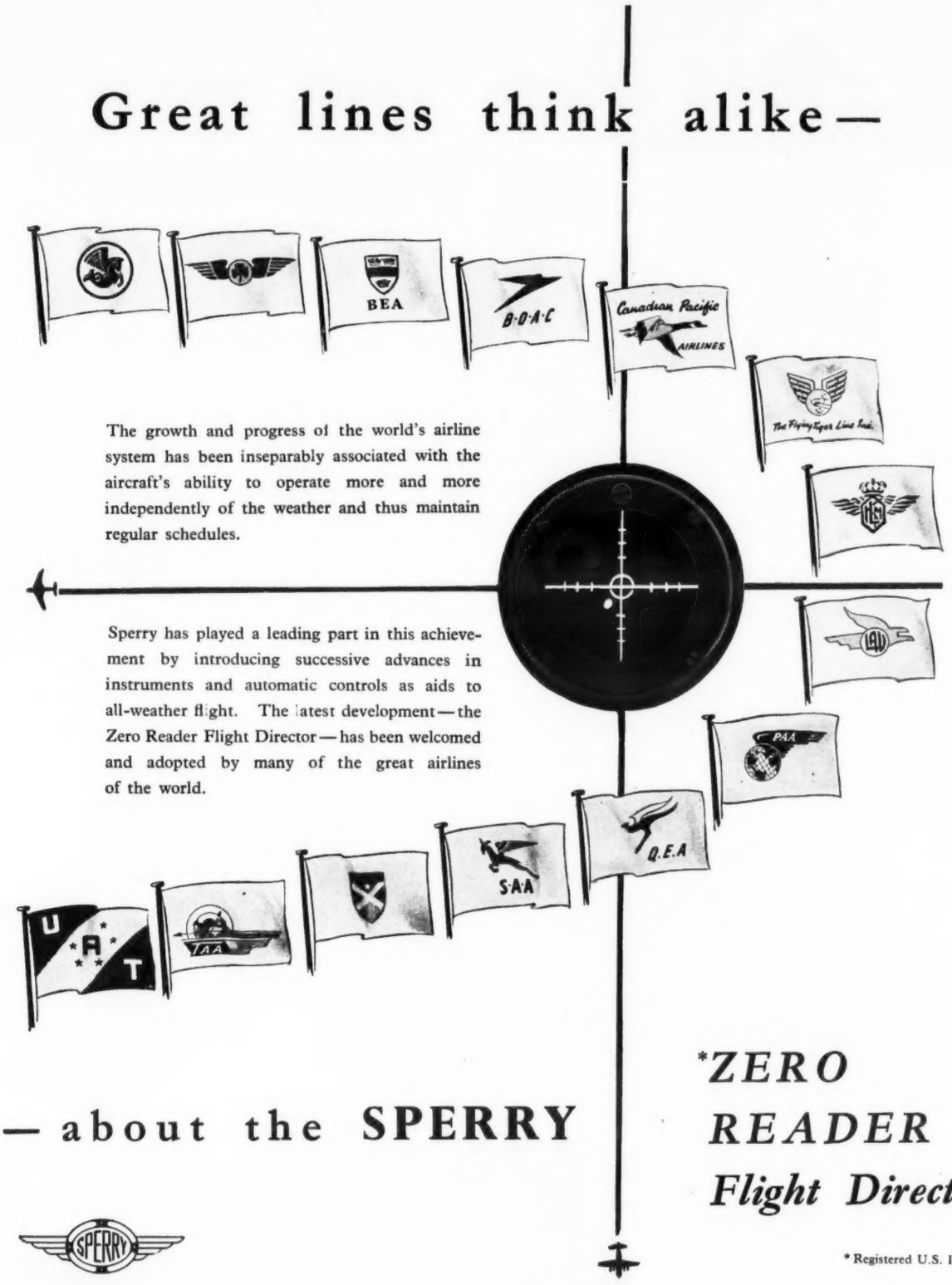

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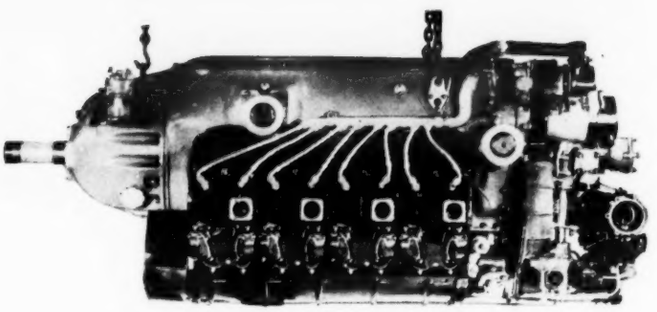

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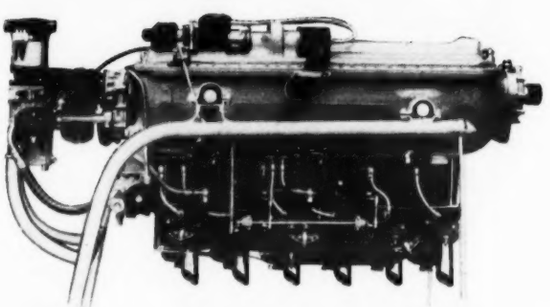

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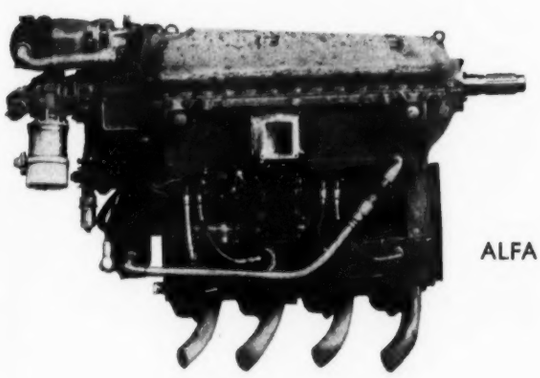

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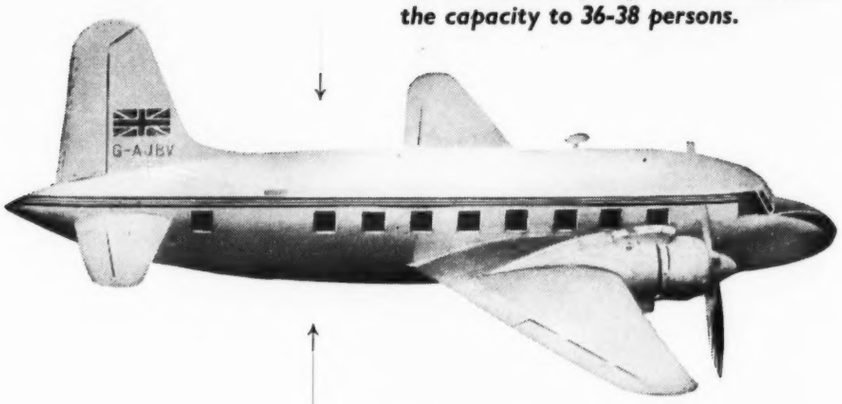
FOR YOUR IMMEDIATE ATTENTION...

Aviation Servicing Limited, have purchased a number of Vickers Viking Mark 1 B aircraft from British European Airways.

These aircraft are now OFFERED FOR SALE either singly or in fleet units, together with spares and ground equipment. Hire Purchase terms will be considered, also part purchase, part leasing arrangements.

The aircraft are the long-nose, metal-wing version of the Vickers Viking and, whilst at present equipped to carry 27 passengers, Aviation Servicing will undertake to carry out conversion if required, to increase the capacity to 36-38 persons.



Vickers Viking aircraft are of proven reliability and have been operating on the European routes with great success.

BRIEF SPECIFICATIONS

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Bristol Hercules 634 fitted with all modifications to latest Bristol Aeroplane Co. standard.

PROPELLERS
ROTOL R44/456/4. Hydraulic, 4-bladed, metal.

ELECTRICAL SYSTEM
24-volt d.c. generators: Type 02, 30 volt, 3,000 watts.

ACCOMMODATION
Crew: 3 and steward. Passengers: 27 in separate non-adjustable chairs (9 in forward cabin and 18 in aft cabin). Galley, toilet and coat space at rear.

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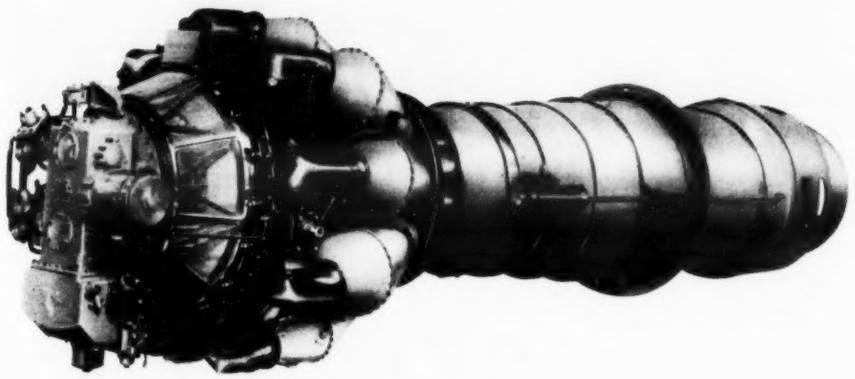

«NENE» TURBOJET
with Hispano Suiza reheat

La Société d'Exploitation des Matériels

HISPANO SUIZA

is showing on its stand
3 turbojets built under « Rolls-Royce » licence

«NENE»

type 105 with double entry centrifugal compressor. Single-stage axial-flow gas turbine. Nine combustion chambers.

Diameter:	49.5 in.
Length:	96 in.
Weight:	1,610 lbs.
Revs.:	12,500 r.p.m.
Thrust:	5,180 lbs.

Fitted in France in the "MISTRAL" and MD 450 "OURAGAN" production aircraft and prototypes of the SO 30, SO 6021, SO 6025, SO 6026, SE 2410, SE 2415, Nord 2200, Bréguet 960-01 and Bréguet 960-02.

«TAY»

type 253 with centrifugal compressor and Hispano reheat, derived from the "Nene", with which it is interchangeable.

Diameter:	50 in.
Length:	99.6 in.
Weight:	1,870 lbs.
Revs.:	12,300 r.p.m.
Thrust:	6,280 lbs.
Thrust with reheat:	9,700 lbs.

The TAY type 250 (6,280 lbs. thrust) is fitted in the Marcel Dassault "MYSTÈRE II", three «MYSTÈRE III» prototypes and the "MYSTÈRE IV A" ordered in quantity.

«AVON»

type RA 7 with axial compressor and complete de-icing system

Diameter:	42.4 in.
Length:	119 in.
Weight:	2,346 lbs.
Revs.:	7,200 r.p.m.
Thrust:	7,500 lbs.
Thrust with reheat:	9,500 lbs.

To be fitted in France in the Dassault "MYSTÈRE IV B", HUREL-DUBOIS HD 45 and SE 210 "CARAVELLE". Fitted in Britain in the Hawker "HUNTER", Vickers "VALIANT", Supermarine "SWIFT" and 508, DH "COMET II", English Electric "CANBERRA", DH 110, Short SA 4 and, in Canada, the Avro "CANUCK".

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DEADLINE NOTES

No. 6/1953

CONGRESS VERSUS WILSON - Criticism of the Air Force policy of the Eisenhower Administration, which had been gathering force for two months, recently broke out in an open attack by Democratic Representative Yorty (California) on Defense Secretary Charles E. Wilson. Yorty stated verbally: "We cannot afford to have the Defense Department headed by a defeatist Secretary whose vision is so circumscribed by dollars, profits and grossly exaggerated economic strain that he is willing to concede the Soviet's dominance of the air indefinitely."

Immediate cause of controversy: Cuts in aircraft procurement funds from $7,000,000,000 to $6,300,000,000 for aircraft already ordered and from $6.700,000.000 to $3,500,000,000 for future procurement. - The Congress view: No change should be made in the programme for obtaining the 143-wing Air Force by July 1st 1954, so as to meet the Russian threat. - Wilson's view: Wilson can see no need to aim at a fixed-size Air Force by a fixed date based on a purely estimated Russian readiness to attack.

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NEW FACES IN THE PENTAGON - Chairman of the Joint Chiefs of Staff: Admiral Arthur Radford (hitherto Commander-in-Chief, U.S. Naval Forces, Pacific; replacing General Omar N. Bradley). - Chief of Staff, U.S. Army: General Matthew B. Ridgway (hitherto Supreme Commander, Allied Forces in Europe; replacing General J. Lawton Collins). - Chief of Naval Operations: Admiral Robert Carney (hitherto Commander-in-Chief. Allied Naval Forces, Mediterranean; replacing Admiral William Fechteler). - Chief of Staff, U.S. Air Force: General Nathan F. Twining (appointed for two years only, as nearing retiring age; hitherto Deputy Chief of Staff; replacing General Hoyt S. Vandenberg.

*

INDIA NATIONALIZES AIR TRANSPORT - The bill nationalizing all air transport in India has been passed by the House of the People, so that all nine Indian airlines and their subsidiaries, employing a total of 9000 persons, have now passed into Central Government ownership for a total compensation of $9,600,000.

*

LOCKHEED STARFIRE - MiG-15 NIGHT BATTLE - A Lockheed F-94C Starfire night fighter, armed solely with rockets, shot down the first MiG-15 in night combat in an engagement over Korea on May 10th (information not revealed to Press until the end of May). This would seem to indicate that the night version of the MiG-15 is now in front-line service.

*

FROM DUTCH AIR FORCE TO KLM? - Lieutenant-General Isaak A. Aler, who is to retire from his duties as Commander-in-Chief of the Dutch Air Force in November 1953, is said to be considering joining the management of KLM (perhaps as future successor to Dr. Albert Plesman).

*

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

PAA'S 1952 RESULTS... A TRIUMPH FOR TRIPPE - Pan American World Airways reports a net profit of $6,673,000 for 1952, the highest profit in the company's 25 years' history (1951: $6,546,000). The number of passengers carried increased by 11% to a total of 1,426,000. Today PAA carries 31% of all Atlantic passengers and 28% of all travellers entering or leaving the United States by air or sea.

*

AMERICAN AIRCRAFT INDUSTRY CIVIL DELIVERIES UP BY 88% - The United States Defense Department announces that a total of 3509 civil aircraft (value $197,200,000) were delivered in 1952, compared with 2477 aircraft (value $88,800,000) in 1951. Increase: 42% in number, 88% in value.

*

WARNING AGAINST OVER-TAXATION OF INDUSTRY - In 1952 the twelve leading firms in the American aircraft industry made a net profit of only 2.2% of total turnover (after allowance for taxation), despite an increase of 88% in sales, states the Aircraft Industries Association. It warns the Government not to tax industry so far that it cannot acquire reserves to carry it over possible periods of crisis.

*

GLENN L. MARTIN RETIRES - On May 16th Glenn L. Martin, founder and ex-chairman of The Glenn L. Martin Co., announced his decision to retire.

*

OURAGANS FOR INDIA - Negotiations between the Governments of France and India for the supply of 60 to 70 Dassault MD 450 Ouragan fighters have entered their final phase.

*

WORKSHOP BRIEFS

The first Douglas DC-7 four-engined airliner for 69 passengers made its first flight at Santa Monica on May 18th. Four Wright R-3350 compound engines with a total power of 13,000 hp; cruising speed: 365 mph. *** A full-scale model of the Douglas DC-8 jet airliner has been mentioned for the first time. Accommodation for 120 passengers on Atlantic tourist services; 70 passengers on first class services. Four Pratt & Whitney J-57 (?) engines; cruising speed 500 mph. *** Boeing confirms that the prototype of a four-jet airliner (Boeing 707) should be ready for flight testing in 1954. Pratt & Whitney J-47 turbojets; accommodation for about 100 passengers on tourist-class services. *** A civil version, designed specially for tourist class services, is to be built of the Lockheed C-130 four-engined military transport. *** Designs for light interceptor fighters have so far been submitted by Douglas, Grumman, Lockheed, North American and Northrop. *** First details of some of the new developments expected to be seen at this year's SBAC Display at Farnborough (September 7th to 13th): An Avro jet-powered delta-wing trainer; a new Hawker high-performance fighter with delta wing and supersonic speed; perhaps the de Havilland Comet 3, if ready by that time; probably a new version of the Vickers-Armstrongs Valiant and a new Short naval aircraft not previously mentioned. *** Armstrong-Whitworth (Gloster) Meteor N.F. Mark 13 is a new version of the Meteor N.F.11 two-seater night fighter. The type is destined for the Middle East.*** The de Havilland Venom N.F. Mark 3 night fighter is derived from the Venom N.F.2 two-seater, whose armament and cockpit canopy have been modified.*** The SO 1310 Fafardet compound helicopter started its flying trials at Villacoublay on May 8th.*** No.5 of the Bréguet Provence series (Bréguet 763 Deux-Ponts) made its first flight May 18th, with Burnaud at the controls. It was due to be delivered to Air France early this month. No.6 will pass its acceptance tests at the end of June. By the end of the year, four machines of the type will be in service with the company. *** Construcciones Aeronauticas S.A. announces that its CASA 202 Halcon twin-engined transport will start its trials in June.

"...We Cannot Legitimately Be Absent..."

20th Paris Aviation Show, June 26th—July 5th, 1953

The cover bears the reproduction of a painting which has been hanging in our office lobby for many years. In it the gifted painter Deluc, a contemporary of the heroic age of aeronautics, depicts the early aerodrome of Juvisy, near Paris, complete with the flying machines and ladies' hats of 1909. To the spectator of 1953 the scene looks highly comical, but there is no reason to make fun of it. The matter was no less serious at the time than it is today, and without the Farmans, Blériots, Voisins and all the others there would be no supersonic flight or jet engines in our time.

Though the pioneers of those days succeeded in attracting the populace of Paris Sunday after Sunday, these displays could not be called "aviation days" in the modern sense of the term. The curious public no doubt regarded them as part of a fun fair, a kind of Coney Island. As for the aviators who put on the show, if they got through their acrobatics all in one piece, then they had an opportunity of exhibiting their now mirth-provoking constructions at the *Salon de l'Aéronautique* in the Grand Palais on the Champs Elysées every two years. It was in the winter of 1909 that the first of these Shows took place, and this marked the beginning of the first chapter of modern aeronautics. When no war happened to be in progress—as has occured from time to time in the past forty years—the Paris Show was held at intervals of two years. It still is a cornerstone of aviation history at the present time.

What the Show looks like these days is illustrated by a photograph taken at the 1951 Aviation Day which concluded the last Paris *Salon,* the 19th, to be exact. This is pretty much what the record of the 20th Show, to be held from June 26th to July 5th, will look like, for the event no longer takes place at the Grand Palais on the Champs Elysées. It has now definitely been moved out to *Le Bourget,* one of the great Paris airports, and the French aircraft industry association is busily preparing the place for its guests.

The move was inevitable : a fun-fair in the open, a static exhibition at the Grand Palais for experts and curious visitors has become a world event with a tremendous attendance, increasingly large aircraft, a widely ramified equipment industry—in other words, a decisive factor in world events.

*

For the French hosts the twentieth revival of the traditional aviation show is of special significance. France's industry proposes to show that, after years of war and Occupation, it has entered the world market once again. Paris has meanwhile become the European headquarters of one of the world's greatest buyers, the North Atlantic Treaty Organization. And even if it had not been a habit and a pleasure for aeronautical people in every country to take the trip to Paris every two years, this year they could not afford to stay away. Air ministers and senior air force officers of every possible nationality will study the exhibits in the new halls, on the flight line and in the air at Le Bourget with critical eyes. Competitors may be expected to make a strenuous effort. A large component of British will be present, the Americans will be represented by some of their largest concerns, the Italians will be nearly in full strength, the Swedes and Dutch are sending their latest products. There will be many things to see—jet aircraft galore and others.

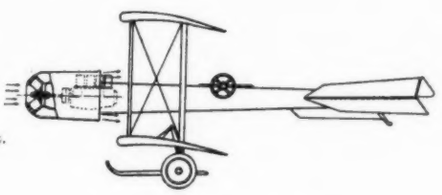
1951 Paris Salon: Aviation Day at Le Bourget.

*

A small reminiscence may demonstrate how inspiring the Paris Aviation Show can be and often has been. At the same time it proves that there is nothing new under the sun . . .

Some time ago an unknown reader sent us issue No. 22 of the first Volume (1910) of the now defunct German *Zeitschrift für Flugtechnik und Motor-Luftfahrt.* On page 291 a Dr. Quittner described the star exhibit of the Paris Aviation Show of a few months earlier—a jet-propelled aircraft !

1910 Paris Salon :
Coanda's jet-propelled aircraft.



" . . . A biplane which aroused much interest at the *Salon Aéronautique* was that exhibited by *Coanda* . . . the most striking feature of the Coanda aircraft is the substitution of a turbine propeller (read : "ducted fan"—Ed.) for the airscrew. The advantages of this propeller are its small diameter and its submerged arrangement, since the turbine operates in a fully closed, somewhat conical tube and thus is better protected from damage than an ordinary airscrew. Tests conducted by Coanda have shown, furthermore, that the efficiency of the turbine propeller is better than the efficiency of the best airscrews available today, for Coanda, using a 50 h.p. engine for tests, has obtained a static traction of 480 pounds . . ."

This "Coanda" aircraft of 1910 thus was the precursor of the Italian Caproni-Campini jet. Britain's Whittle and Germany's Heinkel may disagree on who created the first workable jet engine . . . but apparently fathers also had fathers, and thus it seems to be in the interests of historical accuracy to unearth the "Coanda jet" of 1910 . . .

*

The whole thing started as a popular amusement in the open air, with spectators watching the crazy antics of a group of lunatics flying Heath Robinson contraptions of wood, wire, canvas and glue. In and outside the functional buildings at Le Bourget everyone can measure the long way we have come in the past fifty years, since the time when the Wright Brothers realised the dream of Icarus on the hill of Kitty Hawk in the USA. An army of millions of men and women today earn their daily bread in a mighty industry, an awe-inspiring military arm, in a world-wide system of transportation.

Some time before the Paris aviation days we asked a world renowned British firm of military aircraft manufacturers what they would be showing at the Paris aircraft show this year. In their reply the Company expressed their regret that owing to military reasons their exhibit would be somewhat meagre. They concluded their letter with the sentence: " . . . we feel we could not legitimately be absent."

Nobody will be absent. *E. E. H.*

Paris Air Show

Old and New at the 20th Paris Aircraft Show

BY MAURICE HEURTEUX,

CHAIRMAN OF THE UNION SYNDICALE DES INDUSTRIES AÉRONAUTIQUES, PARIS

It was in 1909 that the first Paris Aircraft Show—then called *Exposition Internationale de la Locomotion Aérienne*—opened its doors to a curious public. It was the first aeronautical show in history; with it a tradition was born. Despite interruptions by two world wars, there has never been any question of abandoning a custom which every two years turns the eyes of the world towards Paris as a sort of "aeronautical Mecca."

From 1909 to 1951 the *Grand-Palais* played host to a succession of the world's most outstanding aircraft and attracted a public that became increasingly interested in the evolution of a science whose civil and military repercussions have revolutionized international economics and politics.

The Paris Aircraft Show of 1953—the 20th—will be not only worthy of its tradition, but will undoubtedly be more successful than ever because of the spirit behind its presentation.

This year for the first time the *Grand-Palais,* too small to house the modern aircraft of today, will defer to Le Bourget Airport as the setting of the *Salon,* a setting amply adequate to accommodate the great show.

Thanks to this initiative, the stands of the manufacturers will all be housed together in a modern and permanent exhibition building erected especially for this purpose. At the same time they will be in the direct vicinity of the aircraft grouped outdoors in one vast static exhibition of aircraft of all weights and categories.

Judging by the imposing number of exhibitors who have already registered for the 20th Paris Air Show, there is no question that the new arrangement will meet a very imperative need.

Significant is the fact that the number of foreign exhibitors who have announced their participation exceeds by far the most optimistic forecasts. The international aspect of the Show is, in fact, already guaranteed by such countries as the United States, Great Britain, Italy, Sweden, the Netherlands, Belgium and others. The attention of the public and the specialists will be focussed on today's most interesting prototypes and on the most recent advances in power plant engineering. The technicians will take advantage of the exceptional opportunity they have of studying the various aeronautical advances which, assembled in Paris from all parts of the world, will provide them with an up-to-date picture of today's progress.

As for France's own aviation industry, so little known and often only through tendentious propaganda, the Show hopes to present French aeronautical achievements in a more favourable light.

A good number of the aircraft making up France's own contribution to the Show will be presented to the public for the first time. We feel sure—without wishing to appear chauvinistic—that the results of our industry's efforts will not remain unnoticed by either the French public or by aeronautical experts from abroad.

Since the Liberation, our engineers have been working persistently to provide France's aeronautical industry with that steady achievement and prestige which characterized its past. The six years of World War II, the difficulties just after the Liberation, and national budgets with insufficient aviation appropriations were obstacles delaying the rehabilitation of France's aircraft industry.

The 20th Paris Aircraft Show can and should be considered as the culmination of a long and sustained effort. Indeed, for the first time France's own contribution will be what might be termed a rational one

Paris Air Show

Events on the Programme

At the time of going to press full details of the 20th Paris International Aviation Show (June 26th to July 5th 1953) were not available. The move from the Grand-Palais on the Champs-Elysées to Le Bourget Airport has changed the whole aspect of the event. In the exhibition hall, accessories, instruments and equipment, as well as some of the smaller aircraft, will be on show. On the field, daily flight demonstrations will take place outside the fixed programme, for the benefit of foreign missions and delegations, visiting NATO officers, engineers and technicians from every part of the world. The final climax will be the two great flying days of July 4th and 5th, the first of which is destined primarily for the aviation world, whose prominent exponents are invited to luncheon on that day at Le Bourget by the French Aircraft Industry Association (Union Syndicale).

*

● *Friday, June 26th:*

Official Inauguration

● *Saturday, June 27th:*

Sporting and Private Aviation Day — Journée de la Jeunesse, flying display, etc.

● *Sunday, June 28th:*

Commercial Aviation Day

Demonstrations by European airlines of their latest airliners; helicopter flights by Sabena between Paris city centre and Le Bourget.

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From June 26th to July 3rd, the visitor's attention will be divided between the static display in the main exhibition halls, the aircraft stationed on the flight line and demonstrations in the air. The following list of aircraft to be shown on the ground and in the air is not necessarily complete.

*

● *Saturday, July 4th, and Sunday, July 5th:*

International Aviation Fête and Flying Display, the first reserved mainly for invited guests, the second open to the public.

1. Aircraft Participating

A. France:

SNCA DU SUD-EST: SE 2010 *Armagnac* transport; SE 2410 *Grognard* ground-attack aircraft; Mk.53 *Mistral* fighters; Sikorsky S-55 helicopter (licence); D.H. *Sea Venom* naval fighter (licence); SE 3120 *Alouette* helicopter.

SNCA DU SUD-OUEST: SO 30 twin-engined transport with *Atar* jets; SO 1220 Djinn jet helicopter; SO 1310 *Farfadet* compound helicopter; SO 6025 *Espadon* experimental fighters; SO 4050-01 *Vautour* twin-jet ground-attack fighter.

SNCA DU NORD: Nord 2501 *Noratlas* transport; Nord NC 856 artillery observation post.

MARCEL DASSAULT: MD 452 *Mystère IV* fighter; MD 316 twin-engined utility transport.

MORANE-SAULNIER: MS 755 *Fleuret* two-seater jet trainer; MS 733 2/3-seater trainer.

LOUIS BRÉGUET: Bréguet 960-02 *Vultur* naval strike aircraft.

HUREL-DUBOIS: HD 31 twin-engined transport prototype (high aspect-ratio wing).

SNECMA: Two Dassault *Ouragan* fighters with Atar 101 jet; Dassault *Mystère* with Atar 101 jet; D.H. *Vampire* with jet deviation; pulse-jet glider (Escopette).

SIPA: S.200-01 and S.200-02 *Minijet* trainers.

FRENCH NAVY: Lockheed P2V *Neptune* patrol bomber; Sikorsky S-55 helicopter.

HENRI POTEZ: Potez 75 trainer.

throughout. Each aeroplane exhibited will exemplify a special research programme, either commercial or military. The problems of design projects surpassing our means, or of irrational aims, no longer exist.

In the military domain, aircraft such as the Dassault *Mystère IV*, the SO 4050 *Vautour*, the SE 5000 *Baroudeur*, the *Potez* 75, the Fouga 170 R *Magister*, the Morane 755 *Fleuret*, and the SIPA 200 *Minijet* are prototypes of international class or illustrate significant new design trends. On the other hand, quantity-produced trainers such as those of SIPA, Morane and Dassault, and first-line aircraft such as the *Noratlas*, *Ouragan*, *Mistral* and *Sea Venom* serve to demonstrate France's ability in the field of production.

As regards civil airliners, transports such as the SE 2010 *Armagnac*, Bréguet 763 *Deux-Ponts* and SO 30 P *Bretagne*, carrying the markings of the airlines operating them, prove that they have fully emerged from the experimental prototype stage. On the other hand, the Hurel-Dubois HD 32 and the Max Holste 1521 are prototypes whose design and economic characteristics are such that their later quantity production cannot be doubted.

In the helicopter field, the SE 3120 *Alouette* and the SO 1120 *Ariel*, 1220 *Djinn* and 1310 *Farfadet* open new vistas for French rotary-wing developments.

Finally, in the research and experimental domain, the results obtained with the SE 2415 *Grognard*, the SO 6020 *Espadon*, the Bréguet 960 *Vultur*, the Leduc ramjet aircraft, the SO 9000 *Trident*, and the delta-wing SFECMAS 1301 serve to show that French designers are certain to win an important place in international aeronautics of the future.

The 20th Paris Air Show, in offering to the international public a unique opportunity of witnessing the progress of world aviation, will be playing a role for which it is perfectly qualified. We sincerely hope that once again it will prove an occasion on which the countries participating will join their efforts for the common good, and on which France's own industry can be judged impartially.

Le Bourget's control tower rises 55 ft. above the apron. Its upper floor houses the control room, the lower floor the radio-electric equipment.

Le Bourget's New Control Tower

Le Bourget Airport, Paris, scene of the 20th International Aircraft Show, has a new control tower which is among the most up-to-date installations of its kind in Europe. The tower's control room is 44 ft. above the central apron, is 11 ft. high and covers an area of 505 sq.ft. The huge windows slant inwards, to avoid reflections, and have double panes of special glass (thermopane), between which filtered, dried air circulates, for sound-proofing and heat insulation. Inner and outer panes are of different thicknesses, to avoid resonance vibrations. Floors and ceilings are also double and sound-proofed.

The floors carry pipes through which hot water flows in winter and a cooling fluid in summer. To ensure accurate temperature control there is also a blower system which sends in warmed or cooled air according to the outside temperature, and provides ventilation for the hermetically-sealed control room. Air humidity is 50% to 70%, and room temperature between 18° and 23° C (65° and 73° F) in winter, and up to 7° C (12° F) below the outside temperature in summer; engine noise is almost entirely filtered out.

Except for the microphones, radar screens and remote control instruments (on the upper floor), all the control tower's radio-electric installations are grouped on the ground floor (area 430 sq.ft.). Several spares of each instrument are provided, so that any faulty equipment can be exchanged immediately.

Air traffic control officials at work with microphones, teleprinters, and signal panels. In the foreground the central switch panel for the airport lighting; approach and landing radar screens are *in front* of this panel and can be separated by curtains from the main room.

B. Britain:
BRISTOL AEROPLANE Co.: Bristol 171 *Sycamore* helicopter; Bristol *Britannia* turbo-prop airliner (?).
A.V. ROE & Co.: Avro *Shackleton Mk.2* patrol bomber; Avro 707A experimental delta.
VICKERS-ARMSTRONG: Vickers-Supermarine *Swift* fighter (?).

C. USA:
North-American: F-86 *Sabre* fighter; Republic F-84G *Thunderjet* tactical fighter; Douglas B-26 *Invader* ground-attack bomber; Boeing B-29 or B-50 *Superfortress* medium bomber; *Fairchild* C-119C *Flying Boxcar* transport; *Bell* 47-D-1 helicopter.

D. Italy:
AERONAUTICA MACCHI: Macchi MB 323 trainer.
SAI ING. A. AMBROSINI & Co.: Ambrosini *Super-7*.

E. Sweden:
SVENSKA AEROPLAN A.B.: SAAB *Safir* trainer-tourer; SAAB J/29 jet fighter (?).

F. Holland:
ROYAL AIRCRAFT FACTORIES FOKKER: Fokker S.13 crew trainer; Fokker S.14 « Mach trainer » jet.

*

Formation Displays
II and III: Paradrops

One battalion of 450 paratroops and two Marine Commandos of 25 men each, making a total of 500 men.
Jeeps, supply containers, 120-mm mortars, mobile field guns, motorcycles.

IV: Fly-pasts and Aerobatics of approximately 100 NATO aircraft

USAF: 25 F-84 *Thunderjets*; 24 F-86 *Sabres*; B-26 *Invaders*; B-29 or B-50 Superfortresses; 8 C-119 *Flying Boxcars*.
Aerobatics demonstration by one flight each of the USAF, the French Air Force and the Royal Air Force. Demonstration by a USAF Rescue Squadron.

*

International Aeronautical Congress

The *Association Française des Ingénieurs et Techniciens de l'Aéronautique* (AFITA), will hold its traditional International Aeronautical Congress during the 20th Paris Aviation Show, under the auspices of the *Union Syndicale des Industries Aéronautiques*. The general subject chosen for this year's Congress is "Production of Airframes," with lectures on all phases of development from design to quantity production.

Paris Air Show

France's Aircraft Industry comes of Age*

Happy outcome of an eight-year obstacle race

BY LIEUT.-COLONEL PIERRE M. GALLOIS, PARIS

Great things are expected in France of this 20th "Salon de l'Aéronautique." Since the end of World War II the struggle to regain lost ground has been unceasing. By now the initial handicap has become very small, and it seems that in certain sectors of the increasingly complex field of aeronautical engineering the margins between performances obtained in this country and elsewhere have never been so narrow. Certain types of equipment—not yet "conventional"—offer solutions to the air world which has been too preoccupied with other problems to bother with them. True, France's aeronautical panoply covers but a limited range. In it are grouped two categories of flying-machine : the first covers aircraft developed along the lines followed abroad ; it is the result of an evolution pushed forward as rapidly as possible by shortening the various engineering stages to a minimum. In the second, novel "ideas" have indicated short-cuts or explored gaps existing in the world-wide range of designs. The resulting types are therefore not comparable to any others : they still stand alone.

In the "conventional" sector, particularly as regards fighter aircraft, this effort has paid off. Diagram I, in spite of the lack of precision a drawing of the kind perforce implies, illustrates the evolution of comparable aircraft design and engineering in France and the United Kingdom. If two British types have been taken as a basis for comparison, this is because the tactical equipments of air defence are more or less similar both in Britain and in France, whereas they differ considerably in the United States.

When the Vickers-Supermarine *Attacker,* succeeding the D.H. *Vampire* and the Gloster *Meteor,* was displayed at Radlett in September 1946, work was going on on this side of the Channel on the final design of a piston-engined fighter with a top speed of 375 m.p.h. And even though the first French jet aircraft, the SO 6000, took to the air two months after the SBAC Display, it was a purely experimental type and not, like the *Attacker,* a combat aircraft.

Today, without trying to assert which of the three the experts regard as the most efficient, it can be said that from the point of view of performance requirements the Hawker *Hunter,* Vickers-Supermarine *Swift* and Dassault *Mystère IV* are "rubbing shoulders" in the line of fighters that can be recommended for quantity production. Without knowing at what time

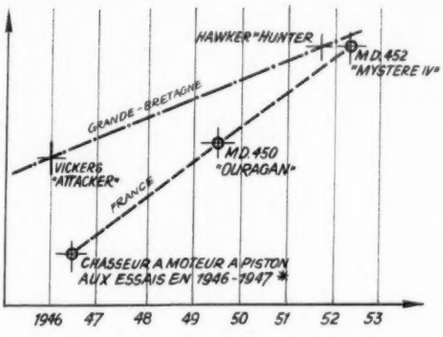


Fig. I : Comparison of Mean Performance of British and French Fighters Hunter vs. Mystère IV

The diagram shows the upswing of the performance curve from the end of the war to the present. Naturally, in reality such a comparison is much more complex and cannot be accurately reflected in a two-dimensional drawing. While it is easy to draw the abscissa and to indicate the stages of progress in time, it is more difficult to mark on the ordinate the sum-total of the qualities characterising an interceptor fighter. In other words, the comparison attempted here is hazardous. But the general sweep of the two curves no doubt is correct on the whole, and this is the fact which must be emphasized.

the two curves typical of the performance achieved in France and Britain will meet or cross, even without inferring that they ever have or ever will cross, it is nevertheless a fact that their present close proximity forcefully illustrates the results of France's effort. Though heavily handicapped by World War II, this effort certainly was favoured by the immediate post-war period when all aircraft engineers were treading water before the same obstacle : the uncertainties of the sonic barrier. This has produced a certain "alignment" of aircraft types approved for combat duty, and included in this "alignment" today are aircraft designed in France.

Smaller lag in power plant race

Transposed to the field of aircraft power plant, the diagram of evolution is obviously no more precise. However rough it may be, it nevertheless indicates a trend (Fig. II). At the time the Gloster E 28/39 took to the air, powered by the W.1. jet (May 15th, 1941), French designers, shackled by the Occupation, were limited to little more than dreams. By successively developing the R.R. *Welland,* the *R.R. Derwent I,* the D.H. *Goblin II,* the R.R. *Nene,* the R.R. *Avon* and the A.S. *Sapphire,* Britain had launched herself on the way towards world supremacy in turbojet design. All these engines were conceived in wartime or in the immediate post-VE-Day period. This meant that all the French could put up in comparison were turbines designed clandestinely on paper, without the assistance even of the most elementary test bench data and indispensable raw materials. The continuation of design studies initiated by the Germans and the "family" of engines derived from the early *Atar* has made it possible, to a certain extent, to shorten the handicap in this race behind the world's best jet-engine builders. More so even than in the case of airframes, comparisons are not easy. One cannot directly compare two

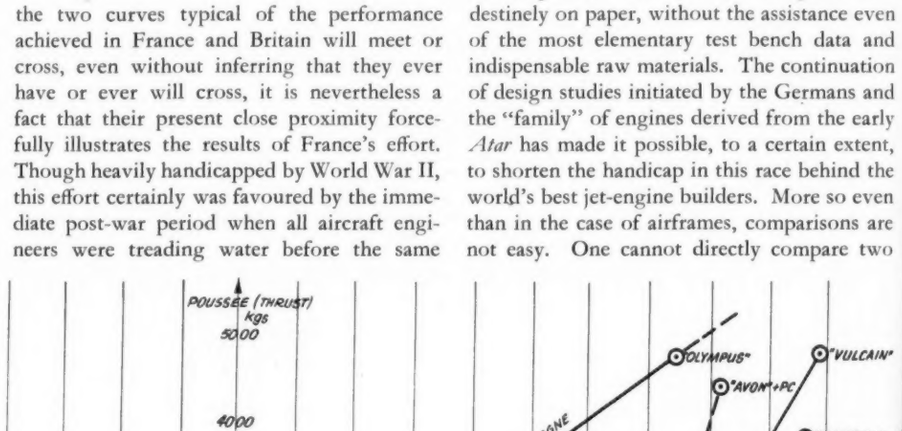


Fig. II : Evolution of Turbojet Output in France and Britain

The continual increase in turbojet thrusts obtained in France and Britain is illustrated by these two curves. Here again, comparison is difficult, because the two "families" of jets chosen are very different from each other. However, if one considers nothing but actual thrust delivered, regardless of, say, specific consumption and other factors, one will observe the gradually decreasing distance between the two lines over the past five years. (Note : PC = *post-combustion* = afterburning.)

* The new French aircraft mentioned below are described and illustrated in the article entitled "France's Aircraft Industry—1953" (pp. 317-323).

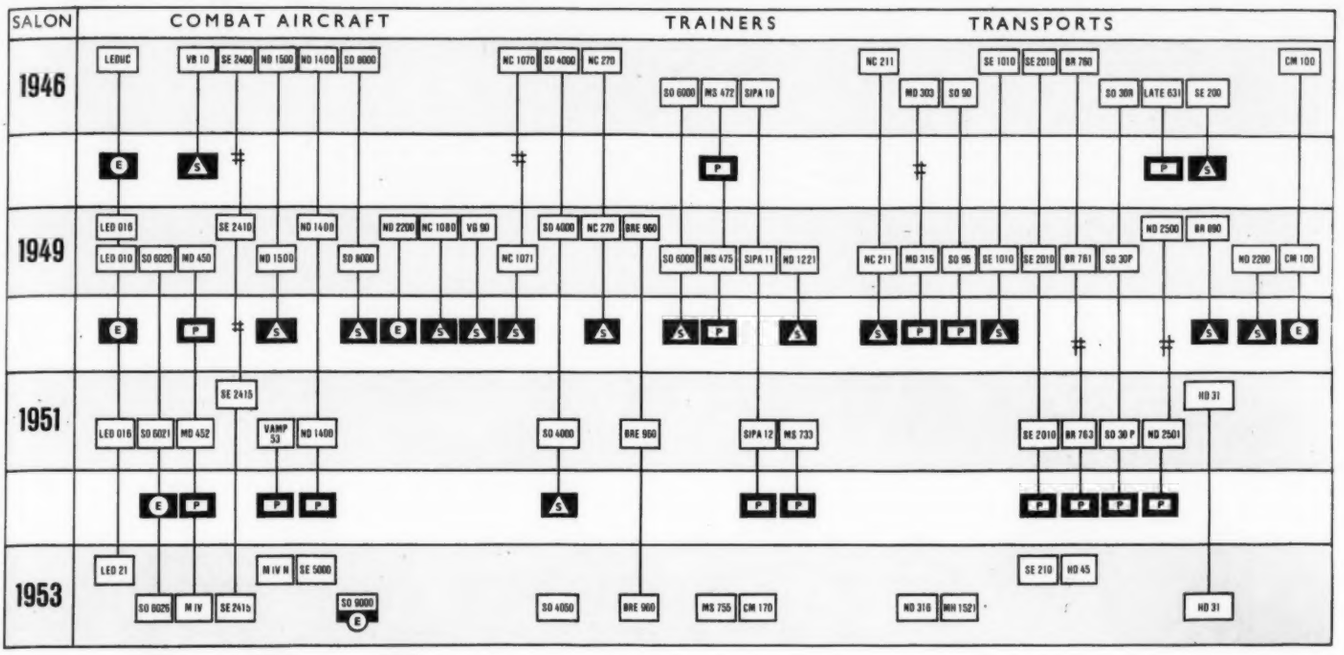


Fig. III : Evolution of French Aircraft Design and Production

This table discloses the different types of aircraft exhibited in full size or as scale models at the Paris Shows of 1946, 1949, 1951 and 1953. For each Salon two rows are indicated : the one at the top shows aircraft which had not flown at the time, the lower one aircraft which had made their first flights in the Salon period. The evolution of the various types is also indicated in order to illustrate their "pedigrees" and their ultimate fate (S = stoppé, or design abandoned ; E = experimental ; P = in production). The diagram reveals the progressive concentration of design work and the improvement in the quality of the types displayed.

engines as different in their designs as the *Atar* and the *Avon*. The former's outstanding qualities are its relative ease of production, its independence of certain rare and costly materials, and its small diameter. The latter is an efficient high-performance engine with lower fuel consumption and longer life, but more costly in production man-hours and special raw materials. The *Avon* is suitable for commercial transport aircraft and enhances the operational and logistic qualities of combat aircraft it powers. The *Atar* aims at meeting military requirements in the form of a compromise between performance, ease of maintenance and handling, and cost of production. But the *Atar* also is the first tangible result of a formula—paralleling the line of "thoroughbred" jets developed on the other side of the Channel—for gas turbine engines of simpler design and perhaps better adapted to the potentialities and essential needs of this country. While a straight comparison thus is impossible, one fact stands out: the engine powers attained are approaching each other with a much less prohibitive time-lag. It is quite true that the abrupt change of tack towards jet-propulsion at the end of the war has helped to make up for time lost during the hostilities. Excluded for five years from that formidable testing and development process of the piston engine which took place in all parts of the world, France's engine designers would never have been able to catch up with the big piston-engine producers elsewhere. Increases in operating life and power output result from hundreds or thousands of flying hours rather than from ingenious designs and advanced computations. In the absence of such a world-embracing test-bench the race would have been futile —had there not occured this change of course towards jet propulsion. Although they started at much later dates, even the least favoured competitors were given a chance by the change-over. Figure II illustrates in diagram form the results of the efforts made in France in the jet propulsion field.

The two courses followed by the jet interceptor and the increasingly powerful turbojet engine have been covered by renowned and imposing pioneers. The handicap race in which France's engineers have engaged promises to end, if not in their final victory, at least in an honourable finish, since today they are only a nose length behind their foremost competitors. But there are new ways and means, as yet unexplored outside of France, which French designers are seeking to utilize for the very reason that France has lagged behind and that her resources are limited.

The short-cut via novel solutions

In the first place, and as part of the policy of discovering new solutions to old problems, there should be mentioned the work of the aircraft designer Hurel. At the Paris Salon of 1949 the HD 10 flying model excited widespread curiosity. The extraordinary aspect ratio of the wing, the revival of those wing struts which had been abandoned almost since the time of the *Spirit of St. Louis*, its slight fuselage and the miniature engine which pulled the combination could not fail to attract attention. But there was a long haul from that light plane to a full-scale economic commercial aircraft, and visitors to the 1951 Show merely saw a small-scale model of a transport aircraft designed on Hurel's principles. Yet the Hurel-Dubois HD 31 is flying today, and its measured performance is superior to the estimated performance figures. The type opens new vistas for commercial air transport (operation economy) as well as for military air transport (use of short runways).

The first test flights made in France by the Fouga CM 170-R, followed by the Morane 755, aroused much interest among the officers responsible for the procurement of air crew training equipment. These types have completely shaken the old theory of a "basic" training phase and an "advanced first phase," both of which have so far been conservatively accomplished on single-engined piston aircraft. A new school of thought has come into being which groups together the first advocates of "conversion" training and even experts on "ab initio" flying training. This group would use light jet-propelled aircraft. The USA are toying with the idea in the form of the Cessna 318. Britain, too, is experimenting in this direction, starting with the conversion of a *Prentice* airframe and following it up with new projects designed around small jets.

Practically speaking, French engineers have succeeded in designing and building two two-seater trainers of a performance similar to that of the *Vampire*, though equipped with engines of only half the power. It seems today that the abundant quantities of obsolescent and

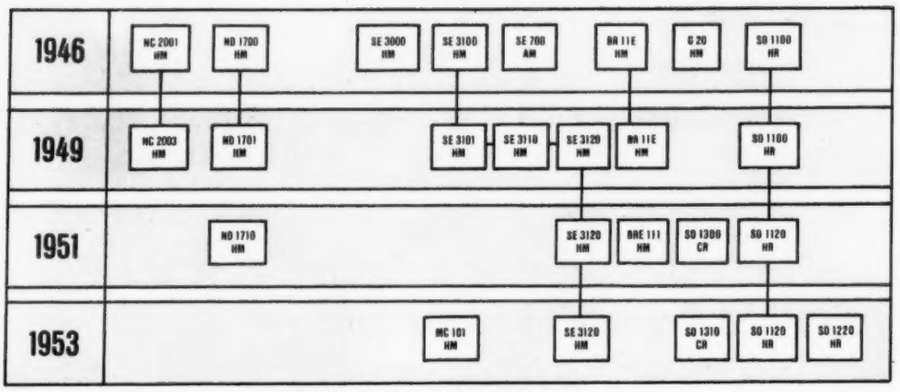


Fig. IV : Evolution of Rotary-Wing Aircraft

The table shows the principal rotary-wing aircraft exhibited in full size or as scale models at the Paris Aviation Shows of 1946, 1949, 1951 and 1953. It emphasizes the progress made with each type and indicates the different derivatives that have evolved from an initially common design principle. The models are the results of a prototype design policy and do not imply the beginning of quantity production of fully developed types. (HM = helicopter with mechanical propulsion ; AM = gyroplane *(autogire)* with mechanical propulsion ; HR = helicopter with jet reaction propulsion ; CR = compound helicopter with jet reaction propulsion).

superseded combat aircraft will suffice to form the equipment for the last phase of flying training. It seems, too, that a very light jet aircraft would never have been able to combine the qualities necessary to train a pilot to the level from which he can safely pass on to outdated combat equipment. The medium-size formula adopted by Morane (side-by-side two-seater) and Fouga (tandem) therefore seems to be amply justified. The Allied experts studying the advantages and drawbacks of the respective location of the pupil's and the instructor's seats will shortly express their opinion as to the most suitable arrangement. However, it already seems to be accepted as a fact that an airframe designed for speed combined with small jet engines meets a need in modern pilot training. The principle as such is hardly under discussion any more, though the seating arrangement still is.

With its SO 4050 and SO 9000, SNCA du Sud-Ouest has attempted to fill two gaps in the inter-Allied aircraft procurement plans. For immediate use it proposes the *Vautour,* for a more remote future the *Trident.* Since modern ground attack fighters (such as the Republic F-84 G) have become capable of carrying "baby atom-bombs" and since the light bomber has disappeared from the range of ground-attack weapons, confusion is rampant among staff officers and in the specialised design offices. Since the conventional bomb, released at great altitude and very high speed, has ceased to be effective, and remote control has had to be added to the force of gravity, there has been growing uncertainty regarding the characteristics of the aircraft best suited for low-flying ground attack missions. The *Vautour* offers a solution incorporating high speed and sustained action since, as a two-seater, it is designed as an all-weather attack aircraft.

Light-weight, though not expendable

The SO 9000, that astonishing machine, with its thin, pointed fuselage and stub wings, is the result of the same desire to offer a solution to problems not previously dealt with elsewhere. The light interceptor of high climbing and horizontal speed but of relatively short range, reveals itself as an increasingly important complement to the medium-weight interceptor fighter which so far has been the only category of fighter produced in Western aircraft factories. While its design speed gives it a place in the French aviation picture that is somewhat analogous to that occupied in the United States by the Bell X-1, this product of SNCASO resembles much more a light combat aircraft capable of intercepting attacking bombers in flight. In the field of the light interceptor too, design studies are now in progress both in America and Britain. "Semi-miniature" in size, simple in construction, fitted with rudimentary equipment, very high speed but "chained like a watchdog" to its base by its short range—these are the general characteristics, in varying degrees, of the new category of target protection interceptors. The first prototypes will fly some time in 1954; the SO 9000 has been flying since early 1953.

There is no country more fully aware than France of the heavy burden imposed by the long runways required for modern combat aircraft, particularly the fighter bomber. They are highly vulnerable, reduce the mobility of combat units, are very costly and are often difficult to accommodate in hilly country. The SE 5000 *Baroudeur* ground attack fighter has been designed to do without such long runways. Here again an attempt has been made to solve a problem which has received scant attention elsewhere, perhaps because the drawbacks of the "conventional" long runways are not so vital in other countries.

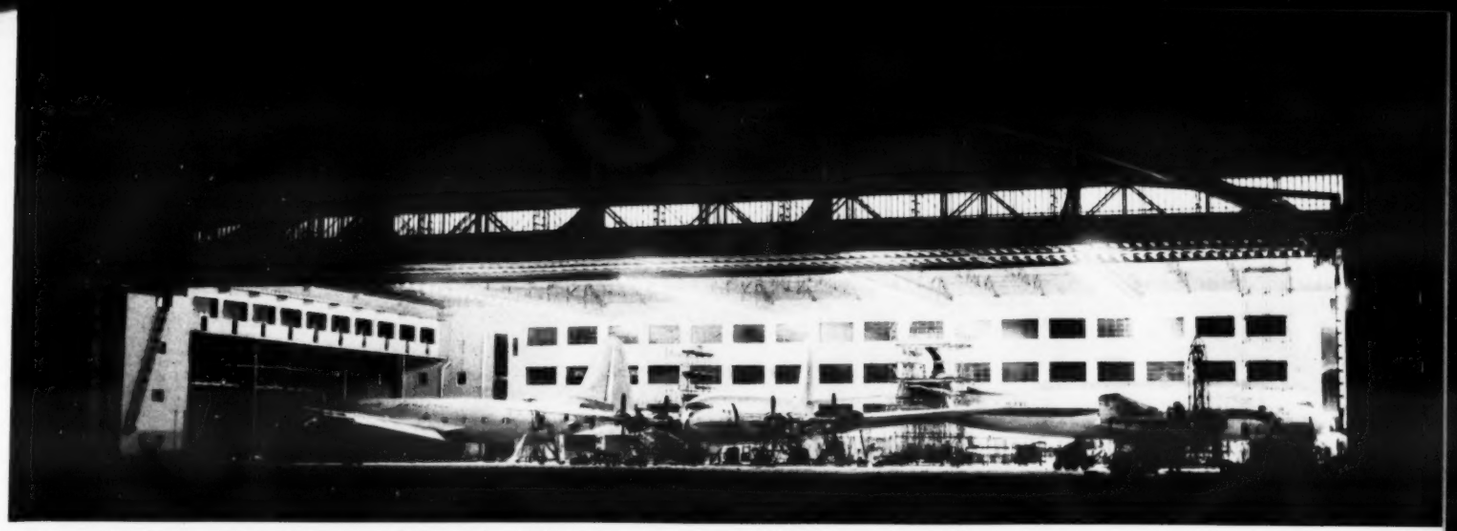
The MH 1521, which will take part in the flying at Le Bourget, is not a very revolutionary type. Nevertheless, it meets a national demand—for a "flying jeep" for service in the overseas territories. It seems that its designer had in mind the renowned de Havilland-Canada *Beaver* which in its "winterized" form has become a standard piece of equipment in the Canadian North. "Tropicalized," the *Broussard* is to play a corresponding rôle in Africa.

Though incomplete, this "round-up" suffices to characterize the French aircraft that will be displayed at the 20th Paris Aviation Show. The fact that they are less numerous than in 1949 is due to the "weeding out" that has taken place in the meantime. The limited budgetary appropriations, combined with the increasing cost of design and research, have made it impossible to undertake more than a few projects. The time-lag still apparent in some sectors of aeronautical engineering and the existence of certain gaps in the equipment programmes of other countries formed a challenge to seek novel solutions and fill deficiencies found elsewhere. Finally, specifically national operational requirements had to be given priority. Fig. III shows that the number of major types exhibited or under development in 1953 amounts to only half the number of types scheduled to be shown at the 1949 Salon. However, at least three quarters of the aircraft on display this year are comparable in quality to corresponding types developed abroad, or supplement the incomplete range of other countries' equipment. That was not the case four years ago.

In the field of commercial aviation, evolution has come to a temporary stop. It looks as if, somewhat crushed by the projects adopted in 1945 and 1946 (SO 30 R and SO 30 P *Bretagne,* Bréguet *Deux-Ponts,* SE 2010 *Armagnac*), the civilian sector has had to regain its breath before passing on to the next stage—the Hurel-Dubois HD 31 forming the sole exception. However, scale models of the jet-propelled medium transport designs adopted by the Ministry of Transport will be available for inspection.

As regards rotary-wing aircraft, the policy followed in France today is obviously one of prototype development. Figure IV, though incomplete, reveals a kind of mushroom growth. However, anxious to take a short-cut by adapting jet-propulsion to the helicopter, French engineers have lined up an interesting range of prototypes on the principle of the *Ariel* and have made an early start with compound helicopters (SO *Farfadet*). Among conventional helicopters, the light-weight MC 101 and the SE 3120 may quickly become production models, but we shall have to wait until the next Salon before we can talk of quantity production.

The struggle towards maturity in France's aircraft industry is drawing towards its close. And, like the scars on the nation's soil, the traces left by the war are disappearing. But the extreme flexibility of aircraft development allows no slackening of effort. It demands an ever-watchful eye, quick to perceive trends of the future. The array of aircraft organised on the occasion of the 20th Paris International Aviation Show will be particularly brilliant. It will be all the more useful because it will throw light on the trends along which the aircraft of tomorrow will be designed.



SNCA du Sud-Est's new hangar at Toulouse can easily house three SE 2010 *Armagnac* transports ; width of hangar door, 330 ft.

France's Aircraft Industry—1953

Three aeronautical events will draw the cream of the international aviation world to Paris towards the end of June 1953 : The *20th International Aircraft Show* at Le Bourget Airport from June 26th to July 5th ; the *International Aeronautical Congress,* organized during the same period by the *Association Française des Ingénieurs et Techniciens de l'Aéronautique,* also at Le Bourget, and finally the *Aeronautical Electronics Congress* held by the *Association pour l'Encouragement à la Recherche Aéronautique* ... Ample reason for a condensed review of France's aircraft industry as it appears today.

AIRFRAME PRODUCTION

The nationalized concerns

Looking back to the situation two years ago, it is immediately obvious that the nationalized aircraft concerns have now succeeded in removing the last traces of the critical position created by World War II and the immediate post-war years. Machine tools have been extensively modernized and adapted to present and future requirements in airframe production. However, the persistent lack of funds forms a regrettable obstacle, which can only be overcome by the receipt of substantial production orders and the consequent full utilization of plant facilities.

SNCA du Sud-Ouest

As is known, SNCA du Sud-Ouest has a well-equipped research and development plant at Courbevoie, where all its prototypes are built, including the three new designs of the past two years : the SO 1310 *Farfadet* "combination" aircraft, the SO 9000 *Trident* supersonic experimental aircraft and the SO 4050 *Vautour* twin-engined multi-purpose aircraft.

But Courbevoie does not only work on airframes. It has also a large number of research teams working on individual equipment problems. For example, an ejector seat, now operational, has been developed and tested there ; a bicycle undercarriage built by Hispano Suiza (as used in the SO 4050) originated with SNCASO ; and a new metal bonding process was first tried out in the Courbevoie laboratories and developed for practical use.

For quantity production SNCASO has factories at St. Nazaire and Nantes. Now that production of the SO 30 P *Bretagne* twin-engined commercial transport and the SO 94/SO 95 light communications aircraft and small transport has been completed, these factories are building—under sub-contract—wings, fuselage rears and tail units for Marcel Dassault's *Ouragan* and *Mystère* jet fighters. However, as soon as a projected production order for the *Vautour* is made definite St. Nazaire and Nantes, whose production capacity is obviously not fully utilized by sub-contracts, will go on to quantity production of this aircraft of SNCASO's own design.

SNCASO's new designs : The jet-powered SO *Ariel* helicopter series with hollow rotor blades and burners at the blade tips has been mentioned repeatedly in *Interavia.* Although genuine helicopters, they can also be regarded as forerunners of the SO 1310 *Farfadet* compound aircraft. The latter is equipped with a three-bladed rotor for helicopter take-off and landing, and with fixed stub wings and tractor propeller for level flight. Two independent power plants are provided, a 350 h.p. Turboméca *Arrius II* turbine in the rear of the fuselage to feed compressed air to the burners at the rotor blade tips,[1] and a 350 h.p. Turboméca *Artouste II* propeller-turbine in the nose to drive the propeller. Regarded as a pure experimental model in its present form (if required, two or three passengers or two stretcher cases, plus pilot, can be carried), the *Farfadet* may well become a basic type for the development of larger aircraft of this category.

Little is so far known of the SO 9000 *Trident* high-speed experimental aircraft, which may be looked upon as a forerunner for projected supersonic interceptors. All that is definite is that it was designed on the basis of experience with the jet-powered versions of the *Espadon.* Originally developed as a heavy fighter, the *Espadon* got no production orders. Today the four prototypes are used as flying test beds,

[1] At present the SO 1310's rotor is designed on the principle used in the *Ariel,* i.e., supply of compressed air to the blade-tip burners, then mixing with fuel, combustion and exhaust. Later the propulsion principle tried out in the SO 1220 *Djinn* will be used, in which compressed air is expelled from the jet pipes.

The SO 1310 *Farfadet* compound helicopter of SNCA du Sud-Ouest. Diameter of the three-blade rotor, 36 ft. 9 in.; span of the fixed stub wings, 20 ft. 9 in.; all-metal rotor blades, similar to those previously developed for the *Ariel III* helicopter.

The SO 9000 *Trident* straight-wing high-speed experimental aircraft.

The SO 4050 *Vautour* is designed for speeds in the vicinity of Mach 1 ; its span seems to be about 49 ft., its wing area about 485 sq.ft. ; gross weight, 28,000-30,000 lbs.

namely the SO 6020 (Turboméca *Marboré* turbojets at the wing tips), the SO 6021 (for experiments with servo controls) and the SO 6025 and SO 6026 (auxiliary SEPR bi-propellant rockets). The installation of two *Marboré* engines at the wing tips, tried out in the SO 6020, has been repeated in the SO 9000, and the rocket engine fitted in the rear of the fuselage is probably of the same type as that being tried out in the SO 6025 and SO 6026. The metal bonding process and composite materials developed by SNCASO are probably also used in the *Trident*. The tail surfaces, which have neither rudder nor elevators but can be adjusted as a whole, may possibly be operated by the servo control tested in the SO 6021.

SNCASO's third new design, the SO 4050 *Vautour* twin-jet multi-purpose aircraft, has now progressed far beyond the first experimental stage. Its prototype has already completed the first phase of its flight tests, during which the measured performance considerably exceeded the calculated values. Although the prototype for these tests was fitted with two SNECMA-ATAR 101 B turbojets of less than 5,500 lbs. static thrust, it reached speeds of over 650 m.p.h. in level flight. Later these engines are to be replaced by more powerful models from the ATAR range (ATAR 101 C of 6,200 lbs., or ATAR 101 D of 6,600 lbs. static thrust).

Several different versions of the SO 4050 are planned : light bomber, all-weather fighter, ground attack aircraft, fast reconnaissance aircraft. Which of these versions finally goes into production will depend on the Ministry.—In any case SNCASO's working programme on these three types covers a wide sector of aircraft design : rotary wings, jet-powered military types, supersonic research aircraft.

SNCA du Sud-Est

SNCASE has a plant at La Courneuve, similar to SNCASO's facilities at Courbevoie, a well-equipped development centre. In addition to general research, it is working on rotary-wing aircraft. The SE 3120 three-seat general purpose helicopter, for instance, comes from La Courneuve. A workshop carefully guarded from the curious gaze houses SNCASE's latest creations, for example, the SE 5000 *Baroudeur* jet-powered fighter and ground attack aircraft. La Courneuve also builds the MD 450 *Ouragan* fighter and is in part engaged on non-aeronautical production, such as body parts for Citroën cars.

Two years ago SNCASE's vast workshops at Marignane, Marseilles, were chiefly engaged on the licence production of the D.H. *Vampire* jet fighter—in addition to building wings for the SE 2010 *Armagnac* four-engined commercial transport. Today the *Vampire* has given place here to the SE *Mistral* fighter, derived from the former model. Meanwhile the experience gained in building the *Vampire* will be of great benefit in the licence production of the D.H. *Sea Venom* just starting.

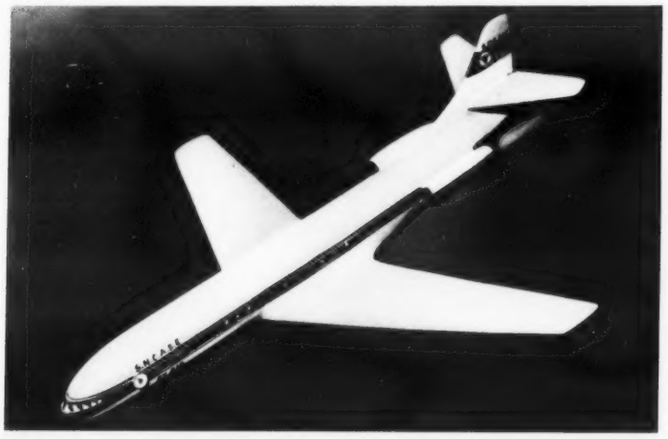
It would be incorrect to assume, however, that Marignane had become a sort of branch of de Havilland's. These licence contracts were only undertaken to keep the trained staff of engineers and skilled workers together ready for the time when aircraft of the firm's own design, now in the prototype stage, can go into production. One of these is the *Baroudeur*, some details of whose design and operational potentialities are given below.

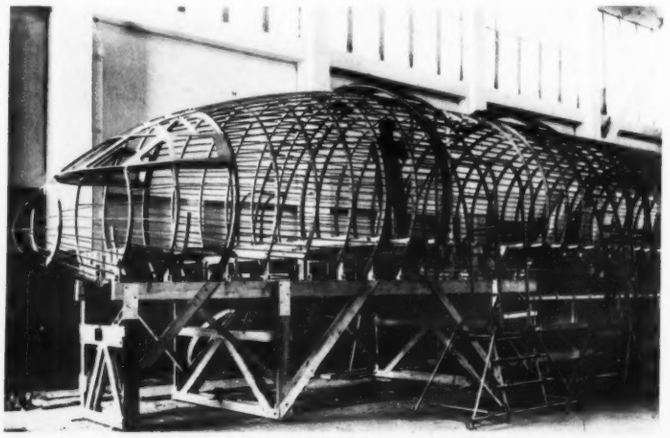
In the SE 5000 *Baroudeur* SNCASE caters to a wide-spread feeling among aircraft designers and military that radical means must be found of putting a stop to the constantly increasing complexity of modern service aircraft. For example, the *Baroudeur*—which has a strongly swept wing and tail-plane (45°+) and is presumably fitted with an ATAR turbojet—has no undercarriage. Take-off is made from a rocket-powered trolley, and landing is on skids which are retracted during flight. This design principle not only produces substantial savings in weight (the fully equipped aircraft is said to weigh just over 11,000 lbs.), but also conditions to a certain extent the aircraft's operational utilization, since it enables it to use airfields of relatively small dimensions, mountain bases, airstrips near the front, etc. The weight of the *Baroudeur* is well below that of modern interceptors, a particularly important point when it is considered that its performance (max. speed 620 + m.p.h.) and armament (probably cannon and a substantial number of rockets) will in no way lag behind those of its "heavy" competitors.

SNCASE's St. Eloi, St. Martin and Blagnac plants near Toulouse are principally engaged on licence production of other firms' designs. Fuselages for the MD 450 *Ouragan* fighter are in quantity production under sub-contract and are to be followed by fuselages for the MD 452 and MD 454 *Mystère*. Quantity production of fuselages for the Dassault MD 311, MD 312 and MD 315 twin-engined "colonial" aircraft will soon be completed. Finally SNCASE, Toulouse, operates a repair base for the French Air Force's Republic F-84 *Thunderjet* fighters.

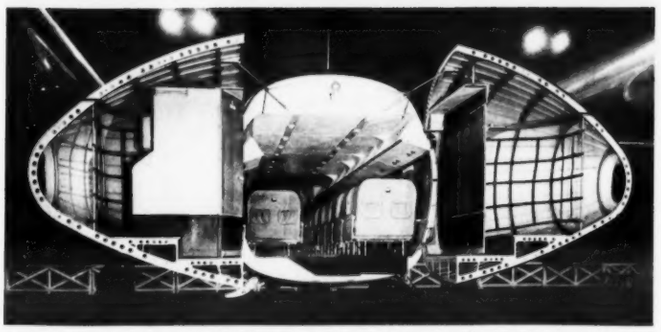
Only a brief reference need be made to the SE 2010 *Armagnac*. As is known, the original quantity order for this four-engined commercial transport was reduced to eight. The

Model of the SE 210 *Caravelle* twin-jet medium transport for 70 passengers, mixed passenger-cargo carriage or pure cargo hauling. Slightly swept wing (22½°) ; gross weight, approximately 80,000 lbs., including 15,500 lbs. payload ; span, 102 ft. 8½ in. ; wing area, 1,530 sq.ft. ; cruising speed, 500 m.p.h. ; power plant, two Rolls-Royce *Avon* jets of 9,000 lbs. s.t. each. A full scale mock-up of the *Caravelle* will be the first construction stage.





The Nord 2501 *Noratlas* spans 106 ft. 7½ in., is 72 ft. ½ in. long and has a wing area of 1,089 sq.ft.



Nord 2501 with open rear-loading doors ; this particular machine is arranged for the carriage of passengers.

seventh *Armagnac* is now ready for flight, and the eighth should follow very shortly.[2]

Incidentally, flight tests of the SE 2410 and SE 2415 *Grognard* twin-jet ground attack aircraft are continuing. These types are unlikely to go into production but will be used for experimental purposes.

The French development programme for medium-stage commercial aircraft with jet propulsion has been discussed in earlier issues.[3] The winners in the contest for medium-stage airliners were the SE 210 *Caravelle* (SNCASE) and the HD 45 (Hurel-Dubois). However, no final decision has yet been made as to which of the two shall be produced in quantity. At the moment one prototype each of the SE 210 and HD 45 are to be built, and the final order will depend on the results of comparative tests. As both prototypes are to complete their certification tests by the end of 1956, first flights will probably take place about the end of 1955.

SNCA du Nord

SNCAN has seven plants. In the outskirts of Paris there are Châtillon, Sartrouville and Les Mureaux ; in the provinces, Le Havre, Meaulte, Bourges and Villeurbanne, chiefly engaged in quantity production. A large number of aircraft types come from SNCAN's factories : the Nord 1200 *Norécrin* touring aircraft, the twin-engined Nord 1402 *Noroit* amphibian, the prototype of the Nord 2200 carrier-based jet fighter, the twin-engined Nord 2501 *Noratlas* transport and finally the NC 856 two-seat artillery spotting aircraft. An order is today in hand for 80 Nord 2501s, and 112 of the NC 856 are to be built. Building of a smaller number of Nord 1402 amphibians has just been completed at Le Havre.

SNCAN's biggest success since the end of the war is undoubtedly the Nord 2501 *Noratlas*. Several plants are building this aircraft. For example, Bréguet makes outer wing sections ; the wing centre section, tail booms and tail surfaces are supplied by SNCAN's Les Mureaux plant; and the fuselages are made at Bourges. Final assembly is also done at Bourges.

Although the eighty *Noratlas* to be supplied to the Air Force are to be equipped as freighters and troop transports, the civilian potentialities of this machine have not been neglected. With the idea of interesting French and foreign companies in the *Noratlas* and also to gather operating experience, SNCAN sent a Nord 2501 with civil equipment to South America at the end of February 1953. The aircraft underwent its "baptism of fire" on demonstration flights in several different Latin American countries, frequently under difficult conditions, and aroused lively interest in particular in Brazil.[4]

PRIVATE ENTERPRISE FIRMS

While the three nationalized concerns form the backbone of the French aircraft industry, a considerable number of private enterprise companies, some of them extremely vigorous, contribute to the overall French aviation picture.

Avions Marcel Dassault

Two years ago, Marcel Dassault was already known as the "strong man of the private constructors"—a sobriquet more justified today than ever. His company, *Avions Dassault*, has plants at Bordeaux, Boulogne and Saint-Cloud. Their output, MD 450 *Ouragan* and MD 452/MD 454 *Mystère* fighters, form a major part of France's entire aircraft production, and this will hardly change in the next few years. The *Ouragan* (Hispano *Nene*) is in quantity production and in squadron service with the French Air Force. Quantity production of the swept-wing MD 452 *Mystère II* (SNECMA-ATAR 101C) and MD 454 *Mystère IV* (Hispano *Tay;* later Hispano *Avon)* is just starting.

The success of the single-seater *Mystère* interceptor has induced Dassault to derive a two-seater night fighter from it, the MD 453 *Mystère de Nuit*. The aircraft, weighing approximately seven metric tons, features a tandem seating arrangement. Unlike the *Ouragan* and *Mystère*, it has "elephant-ear" air intakes on the fuselage sides. Like the *Mystère*, it is said to be in the 620-m.p.h.-plus top speed class.

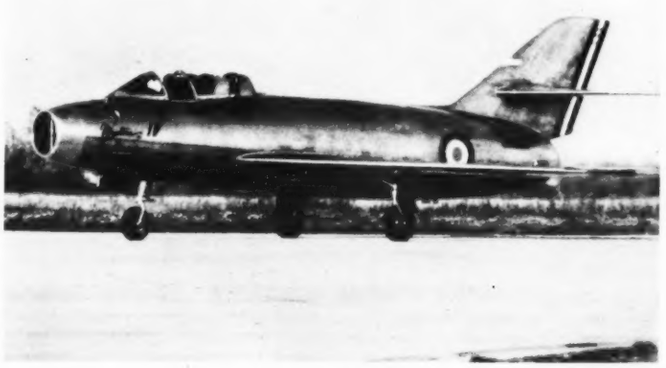
Dassault is now phasing out production of the MD 315 *Flamant* twin-engined military utility transport and the versions derived from it, namely, the MD 311 navigation and bomber trainer and the MD 312 six-passenger liaison

[2] The SE 2010 is in regular service with *Transports Aériens Intercontinentaux*, and four more are to be delivered to this company.—An airlift to Indochina for troops and supplies is to be organized with two *Armagnacs*.

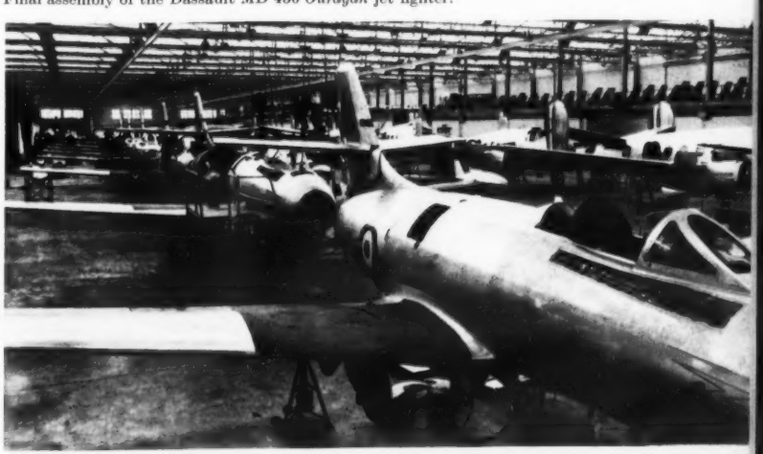
[3] cf. INTERAVIA Review of World Aviation, No. 2, 1953, pp. 99-100.

[4] Aerovias do Brasil has ordered 20 Nord 2501s.

The Dassault MD 454 *Mystère IV* jet fighter. It is powered with the Hispano *Tay* jet.



Final assembly of the Dassault MD 450 *Ouragan* jet fighter.



The Bréguet 960 *Vultur* naval attack aircraft, featuring a composite power plant : an A. S. *Mamba* turboprop in the nose, a Hispano *Nene* jet in the rear fuselage.

aircraft. Of the three versions—the MD 315 and MD 311 have been adopted by the *Armée de l'Air,* the MD 315 by the naval air forces of the *Union Française*—a total of 325 machines will have been built. Finally, there is the Dassault MD 316 liaison aircraft powered with two SNECMA 14 X *Super Mars* engines (six passengers or cargo), which can also be used for pilot or navigation training. A 10 to 15-passenger utility transport version, the MD 316 T powered with Wright *Cyclone 7* engines, has also been built.

Avions Louis Bréguet

Many a renowned aircraft type has been the work of that great French aviation pioneer, Louis Bréguet. After the end of World War II, Bréguet succeeded in a surprisingly short period of time in gathering around him a staff of foremost designers and qualified technicians. At his Villacoublay, Toulouse and Bayonne plants he set out on the development of the Bréguet 960 *Vultur,* a naval attack aircraft featuring a composite power plant (an A.S. Siddeley *Mamba* turboprop and a Hispano-Suiza *Nene* turbojet), as well as of the Bréguet 761/763 *Deux-Ponts* two-deck four-engined transport. Nothing much can be added to the news about the *Vultur.* Two prototypes have been completed ; one of them was flown to Farnborough in the middle of February for aircraft carrier tests (catapult launching). No contracts have so far been awarded, however, and the fate of the type is uncertain.

The history of the Bréguet *Deux-Ponts* four-engined heavy passenger and cargo transport deserves a brief recapitulation : a first prototype, the Bréguet 761 (SNECMA 14 R of 1,600 h.p. each), began its flying trials in mid-February 1949. The aircraft was followed by three Bréguet 761 pre-production models. (P&W R-2800-B.31 of 2,050 h.p. each) which formed the link with the Bréguet 763 production version (P&W R-2800-CA. 18 of 2,100 h.p. for take-off without water injection and 2,400 h.p. with water injection). The Bréguet 763 *Deux-Ponts* (designated *Provence* by Air France) was originally approved for an all-up weight of 106,000 lbs. The type is now to be certificated for 110,000 lbs., and efforts are under way to increase this figure to 115,000 lbs.

Avions Hurel-Dubois

Interavia has previously described the work of *Société des Avions Hurel-Dubois* and the basic principles underlying the company's designs.[5] Hurel-Dubois contends that an aircraft featuring a narrow, high-aspect-ratio wing, aerofoil-shaped lift-increasing wing struts and low-drag wing flaps is capable of unusually high performance even when equipped with relatively low-powered engines. The HD 10 experimental model furnished concrete proof of the aerodynamic qualities inherent in the strut-braced narrow wing ; on the basis of this experience the authorities awarded contracts for one aircraft each of the types *Hurel-Dubois HD 31* and *Hurel-Dubois HD 32.*

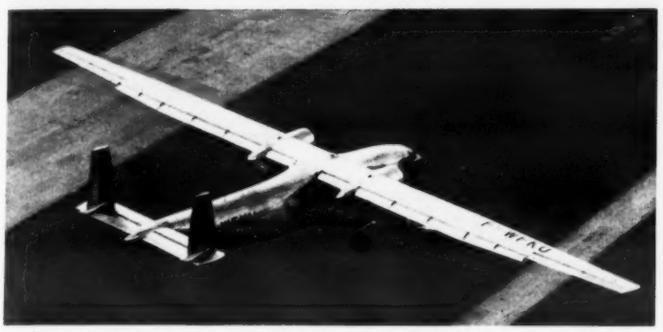
The HD 31, powered with two Wright R-1300 *Cyclone 7* engines of 800 h.p. each, concluded its factory tests in April 1953 with results that are regarded as more than satisfactory ; actual flying and load-carrying performance figures were throughout in excess of estimated values. However, the HD 31 is a mere prototype. The model will now be succeeded by the HD 32 production version, and a production prototype is being built. The HD 32 (P&W R-1830 of 1,200 h.p. each ; same engines as DC-3) is designed for the carriage of passengers and cargo. The passenger version, carrying a maximum of 42 travellers, will have a take-off gross weight of 36,380 lbs. and carry a payload of 10,235 lbs. over 310 miles or 6,280 lbs. over 1,240 miles. In the cargo carrier version the payload for the same stages will be 12,790 lbs. and 8,820 lbs., respectively, at a take-off weight of 38,260 lbs.

No firm contracts have yet been signed, but promising negotiations are in progress. Much interest is also being shown abroad in the Hurel-Dubois designs, since the HD 32 seems to be a strong competitor for the still undecided succession to the Douglas DC-3. Incidentally, some time after the war Douglas Aircraft Co. engineers designed a project somewhat similar to the HD-32 as a successor to the DC-3. Later on, however, Douglas shelved the design in favour of larger, heavier luxury arliners.

Hurel-Dubois does not limit the application of its high-aspect ratio wing to piston-engine aircraft : the *Hurel-Dubois HD 45* designed for the Government's jet-propelled medium-range transport competition will have a narrow wing with a span of 148 ft., an area of 1,184 sq.ft. and an aspect ratio of 18.4. The HD 45 is to carry 80 passengers and 2,200 lbs. of cargo. Powered with two jets totalling 18,500 lbs. thrust, the

[5] cf. INTERAVIA Review of World Aviation, No. 12, 1952 ; pp. 695-699.

Bréguet 763 *Deux-Ponts.* This heavy transport, christened *Provence* by Air France, can accommodate 107 passengers – 59 on the upper and 48 on the lower deck.



The Hurel-Dubois HD 31 narrow-wing aircraft. Span, 147 ft. 7½ in.; aspect ratio, 20.2; wing area, 1,076 sq.ft.; gross weight, 29,760 lbs.; payload, 8,820 lbs. over 300 miles or 5,500 lbs. over 1,250 miles.

Morane-Saulnier MS 755 *Fleuret* two-seater fighter trainer. Span (without wing-tip tanks), 31 ft. 7½ in.; wing area, 194 sq.ft.; gross weight, 5,945 lbs.

type—at a gross weight of 90,000 lbs. to 95,000 lbs.—will have an average cruising speed of 450 m.p.h. over a range of 1,550 to 1,860 miles.

Avions Morane-Saulnier

The company's four factories at Puteaux, Suresnes, Alançon and Ossun, near Tarbes, have produced a whole range of world-famous aircraft types. In the past few years Morane has concentrated all its resources on the design and manufacture of training types and today is continuing the tradition of the MS 435, MS 472 and MS 475 two-seater trainers. At present the company is centering its efforts on the production of the *Morane-Saulnier MS 733* three-seater low-wing monoplane trainer which has been evolved from the earlier MS 730, MS 731 and MS 732 and is powered with a 240 h.p. Potez 6 D engine.

The piston-engine trainers available today have been found to be not wholly adequate for the training of jet pilots, and light, jet-propelled multi-seaters have become indispensable for conversion training. Morane recognized this need some time ago and now presents the Morane-Saulnier MS 755 *Fleuret* two-seater jet-powered fighter-trainer to the public. The *MS 755*, the prototype of which concluded its factory tests at the end of April 1953, is fitted with two Turboméca *Marboré II* jets, each delivering 880 lbs. static thrust, mounted side-by-side in the fuselage. The arrangement was chosen to simulate the flying qualities of single-jet aircraft as closely as possible. If desired, the two *Marborés* can be replaced by a single jet of about 1,800 lbs. s.t.—obviously at the expense of the "twin-engine safety" of the original version.

The performance of the *Fleuret* is much superior to what one has become accustomed to expect from trainers: maximum speed in level flight 430 m.p.h., maximum permissible speed 530 m.p.h. at 20,000 ft., service ceiling 38,700 ft. Like its performance, the MS 755 strongly resembles a combat aircraft: pressurized cockpit, emergency exits for both occupants through hatches in the cabin floor, dive brakes, complete instrument flying equipment, radio compass, etc. In comparison, its armament clearly indicates the trainer: two 7.5-mm machine guns with 400 rounds each, or four 55-lb. rockets or two 110-lb. practice bombs.

The decision whether the MS 755 will go into production is still in the mill. A design developed at about the same time by *Etablissements Fouga* (CM-170-R *Magister*) is equally promising, and comparative trials will be held to determine the winner.

Etablissements Fouga

With its range of jet-propelled light aircraft, including the *Sylphe*, *Cyclope* and *Gémeaux* (all powered with Turboméca engines) Etablissements Fouga & Cie., of Aire-sur-Adour, has aroused international interest and simultaneously laid the foundation of a very close cooperation with Turboméca, the small-jet specialists.

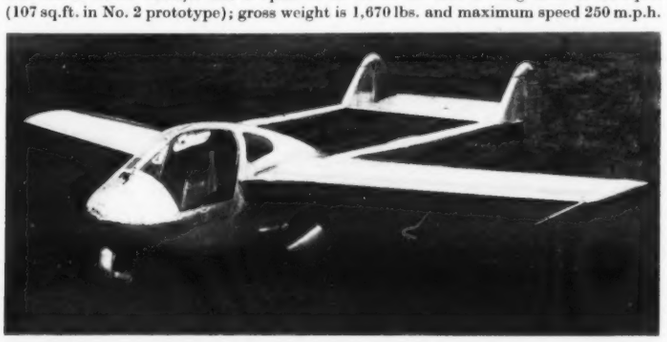
The most noteworthy novelty of the Fouga company doubtless is the twin-jet Fouga CM.170-R *Magister* fighter trainer. As just mentioned, certain parallels can be drawn between the *Magister* and the Morane *Fleuret*. Like the latter, the CM.170-R is powered with two Turboméca *Marboré* jets of 880 lbs. take-off s.t. each. In view of their almost identical gross weights (6,340 lbs. for the *Magister* and 5,945 lbs. for the *Fleuret*) it is not surprising that they are of similar performance: the *Magister* has a top speed of 425 m.p.h. at sea level and 440 m.p.h. at 20,000 ft.; initial rate of climb is estimated at 3,245 ft./min., service ceiling at 34,450 ft. Needless to say, the *Magister* will carry practice armament. Cockpit pressurization, dive brakes, dual controls for the two tandem seats and complete blind-flying instruments are part of the type's standard equipment.

SIPA's activities

With its *SIPA S.901* personal and training two-seater, *Société Industrielle pour l'Aeronautique*, of Suresnes and Villacoublay, entered the field of lightplane manufacture years ago. When Turboméca announced its first miniature jet, SIPA felt that the moment to design a jet-propelled lightplane had arrived. Thus the SIPA S.200 *Minijet* was created, a two-seater trainer powered with a 330 lbs. take-off s.t. Turboméca *Palas* engine. The first prototype completed its manufacturers' tests in the middle of last March and a second prototype started its test flights in May. While the first prototype is purely experimental, modifications were incorporated in the second to make the *Minijet* suitable for future use as a military trainer: conventional dual controls and complete blind-flying equipment. In addition, the second prototype has a wing of slightly larger

Fouga C.M.170-R *Magister* two-seater fighter trainer. Span, 37 ft. 6 in.; wing area, 186 sq.ft.; gross weight, 6,340 lbs.

The SIPA S.200 *Minijet* has a span of 25 ft. 11 in. and a wing area of 96 sq.ft. (107 sq.ft. in No. 2 prototype); gross weight is 1,670 lbs. and maximum speed 250 m.p.h.



area. The cockpit was slightly lengthened, flap control and undercarriage retracting mechanism have been made automatic. Wing-tip tanks give the S.200-02 a range of 400 miles.

The results obtained with No. 1 *Minijet* were so satisfactory that the company's management decided to develop a new type, retaining, however, the *Minijet* wing (NACA Series 6 laminar-flow airfoil). Since it has not yet been decided whether *ab initio* training of fighter pilots will be accomplished on jet-propelled or piston-engined aircraft, SIPA is offering both possibilities in its new *SIPA S.300* two-seater trainer : the model may be powered either with a reciprocating engine or with a jet (Turboméca *Marboré II*).

Besides these developments, SIPA is continuing production of the *SIPA S.12* two-seater propeller-driven trainer for the French Air Force. Of this type, which is derived from the S.10 and S.11, a batch of 50 was nearing completion in mid-April, but a repeat order should by now have been awarded.

The others

In June 1952 *Etablissements Farman* announced a two-seater primary trainer, the Farman *Monitor I*, and thus actively re-entered the field of aircraft construction after a lapse of many years. A prototype was built, which meanwhile has completed its official type approval tests.

Henri Potez, too, has again added an Aircraft Division to its engine factories. Its first products will be the *Potez 75* light attack aircraft designed for close support of the ground

The French Accessories and Equipment Industry

Having overcome a great many difficulties arising from costly prototype ventures, France's accessories and equipment industry has reached a position where profitable quantity production is possible. The production plant of the leading manufacturers—Messier, Air-Equipement, Bronzavia, Compagnie Générale de Télégraphie sans Fil (C. S. F.), Société Française Radioélectrique (S. F. R.), Compagnie Française Thomson-Houston—has been extensively modernized and is now equipped for the production of accessories of all kinds.

Owing to space restrictions, a detailed review of the products of this industry must be left to a later issue.

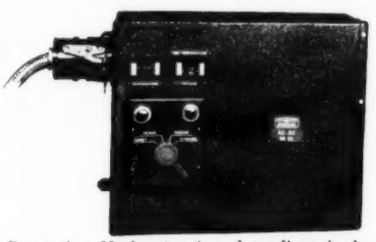
Air-Equipement : Switch-board for a pneumatic de-icing installation.

MESSIER S. A., Montrouge : leading designers and manufacturers of undercarriages (wheels, brakes, retraction equipment, etc.), with which practically all French aircraft (Dassault *Ouragan* and *Mystère*, Nord *Noratlas*, Bréguet *Deux-Ponts*, SO 9000 *Trident*, SE 5000 *Baroudeur* and others) are fitted. Messier undercarriages are also to be found in foreign aircraft (e.g. the Fiat G.80). In addition, Messier makes hydraulic installations and recently brought out the *Ministop* brake pressure regulator weighing only 16 ounces, which enables brakes to be used to their full extent without skid effect.

S. F. E. N. A. (Société Française pour la Navigation Aérienne), Neuilly/Paris : designers of gyroscopes, automatic pilots, radio sondes, VHF radio equipment, automatic position indicators, etc. SFENA makes, for example, the automatic pilots used in the Nord 2501 transport and is developing control equipment for guided missiles.

AIR-EQUIPEMENT, Asnières : This firm's extensive production programme includes starters for piston engines and turbojets, fuel metering equipment and regulators for turbojets, pneumatic de-icers for wings, tails and propellers, and compressed air and vacuum equipment, all to its own designs. In addition, generators, electrical controls, transmitters, receivers and radionavigation equipment and a large number of Bendix Aviation Corp. products are made under licence.

L. C. T. (Laboratoire Central de Télécommunications) Paris, and *L. M. T.* (Le Matériel Téléphonique) Boulogne-Billancourt : both firms specialize in the production of radio and navigation equipment. L. C. T. builds, for example, a DME instrument for short-range navigation, while L. M. T. produces quartz-controlled VHF R/T equipment and automatic VHF R/T D/F apparatus.



Bronzavia : Machmeter (speed readings in knots and Mach number), for a speed range of up to Mach 2 and altitudes of up to 65,000 ft.

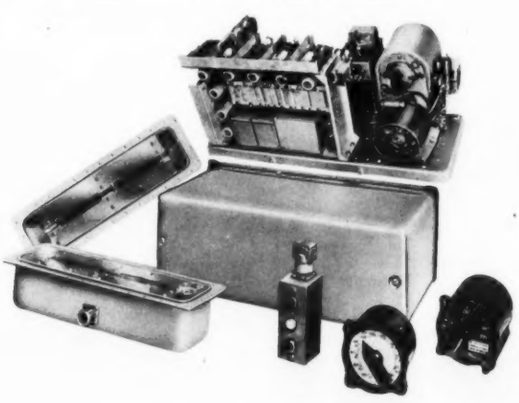
BRONZAVIA S. A., Courbevoie : This firm, which like Air-Equipement is active in almost all branches of accessories production, supplies engine accessories (fuel pumps, carburettors, injection pumps, filters) and pneumatic and electrical equipment (suction pumps, compressors, direct current motors, cabin blowers, automatic cabin pressure regulators and air conditioning plant) in large numbers. Bronzavia also has a well-equipped section for precision mechanics and optical instruments, which produces bomb sights (radar sight for the SO 4050 *Vautour*) and camera guns ; VHF aircraft radio equipment is also made.

S. F. R. (Société Française Radioélectrique) and C. S. F. (Compagnie Générale de Télégraphie sans Fil), Paris : S. F. R.'s chief products are fixed and mobile radar installations, including large surveillance equipment, also instrument landing apparatus (ASV 23) and other airport equipment, and finally radionavigation instruments (radio altimeters, VHF D/F equipment, etc.). On the other hand C. S. F.—under the same management as S. F. R.—is primarily a research centre and prototype manufacturer, with working groups for general research, electronics and applied physics and chemistry.

COMPAGNIE FRANÇAISE THOMSON-HOUSTON, Gennevilliers : Thomson-Houston's "Electronics" group comprises the departments primarily working for aviation : on radar equipment, radio valves, general research.—CFTH has gained an international renown during the past few years by supplying GCA installations for the Brussels-Melsbroeck, Amsterdam-Schiphol, Milan-Malpensa, Copenhagen-Kastrup and Geneva-Cointrin Airports. It also builds air and ship-borne radar instruments.

Messier : Main undercarriage leg for the Bréguet *Deux Ponts*.

Société Française Radioélectrique (S.F.R.) : Radio altimeter for frequency modulation.



Thomson-Houston : Fixed surveillance radar.

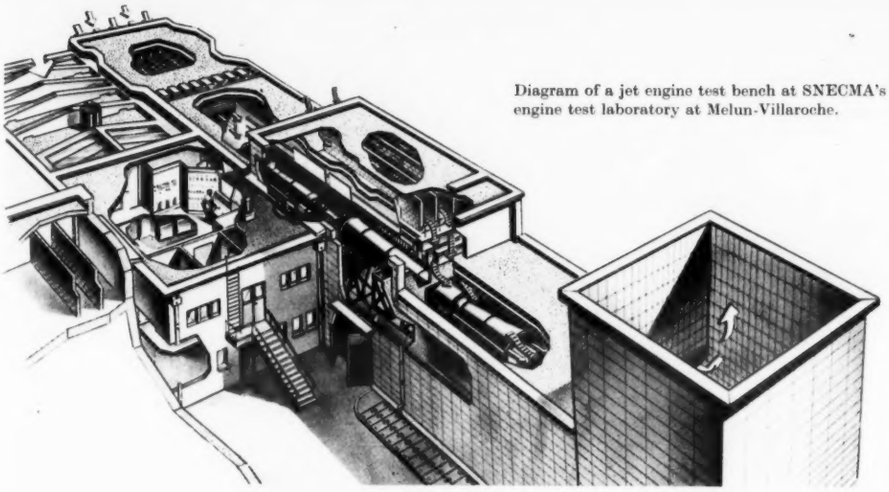


Diagram of a jet engine test bench at SNECMA's engine test laboratory at Melun-Villaroche.

forces. It is to be powered with a 450 h.p. Potez 8 D 32 engine driving a pusher propeller.

More peaceful duties have been assigned to the Holste M H 1521 *Broussard* general utility aircraft of *Avions Max Holste* and to the Boisavia 260 *Anjou* twin-engined executive and liaison transport just announced by Société Boisavia.

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Several other aircraft firms cannot be mentioned in detail in the limited space available, although their products may deeply affect the prospects of the French aircraft industry as a whole. More particularly, they include the ramjet-powered aircraft of *René Leduc*, the *SFECMAS 1301* delta-wing glider which is now undergoing its flying trials, and the *Payen PA 49* jet-propelled delta, which is also undergoing tests ; the PA 49 is a purely experimental model but could later be developed into a light single-seater jet-propelled trainer.

POWER PLANT PRODUCTION

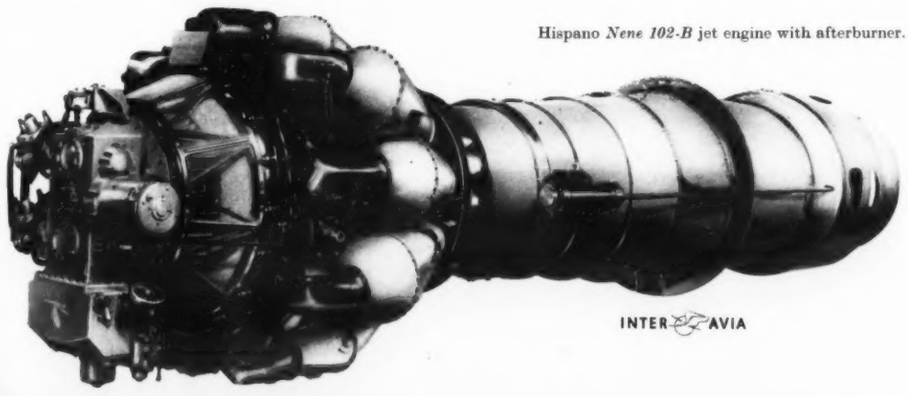
The chief pillars of the French aircraft engine industry are still *Société Nationale d'Etude et de Construction de Moteurs d'Aviation* (SNECMA) and *Hispano Suiza S. A.* Both supply the airframe factories with the majority of their piston engines and turbojets they require. Alongside these two, *Société Turboméca* has been making a name for its small turbine engines, and *Société Rateau* is continuing the development of aircraft turbines in addition to building industrial turbines. Finally, *Société des Moteurs Potez* continues to supply a good percentage of French requirements for piston engines of low and medium power.

SNECMA

Société Nationale d'Etude et de Construction de Moteurs d'Aviation has largely converted during the past few years to development and production of high-power turbojets. A considerable portion of the tooling equipment at the company's Kellermann plant, Paris, has been adapted for the new type of work, and a number of test beds for turbine engines are in operation at the Melun-Villaroche engine test centre which is now nearing completion.

At the moment the Kellermann works, which is used for quantity production of aircraft and also houses the jet research section, are producing the *SNECMA-ATAR 101C* axial-flow turbojet of 6,200 lbs. static thrust. This model is shortly to be followed by the more powerful ATAR 101D of roughly 6,600 lbs. static thrust ; even more powerful ATAR versions (with reheat) are in preparation. A short time ago it was announced that first test runs by the new SNECMA *Vulcain* high-performance turbojet had begun.

In spite of its emphasis on jet production, SNECMA continues to make piston engines (e.g. at its Billancourt plant). The Bristol *Hercules* 14-cylinder sleeve-valve engine is being built under licence for the Nord 2501 transport. On the other hand, nothing much has been heard recently of the *SNECMA 14* 14-cylinder two-row radial. This engine has completed its acceptance tests and has been certificated for a take-off power of 840 h.p., but no orders have yet been received. However it could also be converted for use in helicopters, which would open a new, promising field to it.—SNECMA is also responsible for overhauling 12 S and 14 R piston engines and builds D.H. *Goblin* flame tubes for the French Air Force.—Finally, the Suresnes works house a piston-engine study group and a number of research sections, which are working on the most varied problems of aircraft propulsion (presumably also on the propulsion of guided missiles) : pulse-jet engines, jet deviation in turbojets for landing, braking, etc.



Hispano *Nene 102-B* jet engine with afterburner.

Société Hispano Suiza

Hispano Suiza signed a licence agreement with Rolls-Royce as far back as 1946 for the production of the *Nene* jet of 5,000 lbs. static thrust.[6] Quantity production of the *Nene* began in 1948. Since then Hispano have made numerous improvements, and the latest *Hispano Nenes* deliver 5,180 lbs. static thrust. Hispano Suiza has also turned out a derivative of its own of this engine, the Hispano R.300, three prototypes of which have been built (static thrust 5,950 lbs.). The R.300 has not gone into quantity production, doubtless because Hispano has meanwhile obtained a production licence for the Rolls-Royce *Tay* (6,280 lbs. static thrust). A number of modifications have been made to this engine, and the *Hispano Tay*, now in production, delivers 6,830 lbs. static thrust.

Finally, Hispano Suiza has developed an *afterburner for turbojets* at the request of the French Air Ministry. Official acceptance tests have confirmed that this afterburner gives the Hispano *Nene* an increase in thrust of at least 25%. Adaptations to fit the installation to the Hispano *Tay* have probably now been completed.

Société Turboméca
Société des Moteurs Potez

Société Turboméca of Bordes is known far beyond the frontiers of France as a development firm for a whole series of small turbine engines. Licences for the *Piméné, Palas* and *Marboré* turbojets, the *Aspin* ducted fan engine and the *Artouste* and *Orédon* shaft power plants have been granted to Great Britain and the United States.[7] In many cases Turboméca engines have already been fitted in light experimental aircraft and trainers. Their use as auxiliary power plants to assist take-off, etc., promises well, and rotary-wing aircraft have also been equipped with them. According to latest reports Turboméca is now planning development of medium and high-power turbojets and has started on a 350 s.h.p. propeller turbine.

Société des Moteurs Potez is continuing production of its well-known four, six, eight and twelve cylinder in-line engines with outputs of between 160 and 600/675 h.p. In particular, intensive work is being put into the development of the six-cylinder Potez 6 D range. A *6 D 30* with supercharger and direct fuel injection was recently tested under ICAO conditions at Chalais-Meudon test centre and authorized for a take-off power of 300 h.p. Compared with the performance of the original 6 D 00 model, this means a performance increase of roughly 10 percent.

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The above is a highly summarized report on the activity of the French aircraft industry. Of necessity much has been omitted. For example, security regulations make it impossible to give any details of the work on guided missiles, some of which is well advanced. And a number of special designs in the engine sector have also had to be passed over in silence.

[6] For the production of the *Nene* at Hispano Suiza see INTERAVIA Review of World Aviation No. 6/1952.

[7] Cf. «Miniature Jets for Peace and War», INTERAVIA Review of World Aviation No. 4/1953 ; pp. 204-205.

Foreign Participants at the 20th Paris Air Show

United States

The American aircraft industry's most powerful concern—*United Aircraft Corporation*—will exhibit the world-renowned reciprocating engines made by its *Pratt & Whitney Aircraft Division (Wasp Major, Double Wasp, Twin Wasp)*, as well as turbojets and propeller turbines. It is hoped that the 5,700 h.p. T-34 (or PT-2) propeller turbine will be Pratt & Whitney's "centre-piece." The *Hamilton Standard* division will be showing propellers, pumps and air refrigeration plant, while *Chance Vought* will offer a series of models of its jet fighters (and guided missiles ?). Finally *Sikorsky Aircraft Division* will have sub-assemblies for its S-55 helicopter on show.

Bendix Aviation Corporation is bringing to Paris a selection of its more than 300 products, including ignition equipment and flow regulators for piston engines and jets, starters and generators, radio, navigation and radar instruments, automatic pilots, measuring and checking instruments, etc. Considerable interest will also be aroused by Bendix's meteorological equipment, in particular the apparatus for transmitting measurements from research rockets and balloons, to supply information on conditions in the upper atmosphere.

The *Curtiss-Wright Corporation* which withdrew from aircraft manufacture some time ago and now concentrates on piston engines, turbo-compound engines, turbojets (under licence), propeller turbines, and flight simulators, will also be present in Paris. The Californian equipment firm of *AiResearch Manufacturing Company*, a Division of the Garrett Corporation, will show pneumatic power units, temperature and cabin pressure regulators, air compressors and air turbine refrigeration, electric actuators and electronic controls.

Great Britain

A good half of all the foreign exhibitors will be British. Seven aircraft companies, three engine firms and thirteen accessory manufacturers will be represented this time in Paris. Great Britain is making tremendous efforts to export, and what could be a better international shop window than the Paris Salon?—The *Hawker Siddeley Group* is the chief beneficiary of these export orders and the resulting dollar flow, having recently booked NATO orders to a value of $153,000,000 for 450 Hawker *Hunter* fighters and 100 Hawker *Sea Hawk* carrier-based fighters. *Rolls-Royce*, who is to supply the *Avon* and *Nene* turbojets for these aircraft, is doubtless also highly pleased. All four of these products are expected to be on show in Paris, as well as models from *A. V. Roe* and *Gloster*.

The other six British firms, *Bristol, de Havilland, English Electric, Fairey, Shorts and Vickers Armstrongs*, will probably—as at earlier Shows—be well to the fore in the flying display and will also have several aircraft and a substantial number of models in the static show. Old acquaintances from SBAC's Farnborough Display, such as the Bristol *Sycamore* and 173 helicopters, the *Britannia, Heron, Comet*, English Electric *Canberra* and Supermarine *Swift*, will no doubt be in Paris.—*Bristol's* and *de Havilland's* engine divisions will be showing sleeve-valve engines, turboprops and turbojets *(Hercules, Centaurus, Olympus, Proteus, Ghost*, etc.).

Of the equipment firms, *Dowty* will bring along undercarriages and shock-absorbing legs, *Rotol* v.p. propellers for gas turbines (for the Bréguet *Vultur* and the Fairey *Gannet)* and an auxiliary gearbox for the *Avon, Thermionic Products* an airport recorder with eight-hour continuous recording on 14 channels, *Normalair* pressure ventilation equipment, etc.

More than 1,000,000 sq.ft. is the area covered by the East Hartford, Connecticut, engine plant belonging to the Pratt & Whitney Aircraft Division of United Aircraft Corp. High-power piston engines, turbojets and propeller turbines are made here.

The Hawker Siddeley Group has received a gratifying NATO order for 450 Hawker F.2 *Hunters*. Chief Pilot Neville Duke (in cockpit) played a valuable part in this success.

Italy

In spite of the difficult situation that has arisen because of the delay in the award of domestic and foreign arms contracts, the Italian aircraft industry will again occupy a major place in Paris. The difficulties are due to the fact that licence production of the D.H. *Venom* and its D.H. *Ghost* engine has been struck off the Mutual Security Agency's off-shore programme for NATO. The *Venom* was to have been the successor to the *Vampire Mk.52,* which had been built in small numbers by Fiat and Macchi (with imported engines), but was found to fall short of the considerably higher standards meanwhile demanded by the military. Fiat, Macchi and Alfa Romeo, who had tooled up for *Venom* and *Ghost* production and had engaged a large number of sub-contractors, were thus "stood up." Considerable sums were invested and lost in the process.

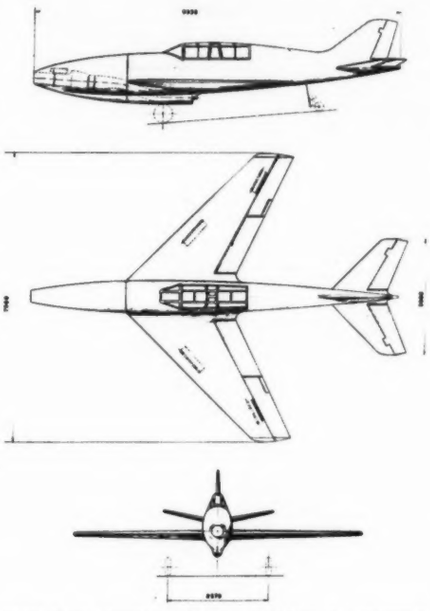
A turn for the better came a few weeks ago, when Professor V. Valletta, President of Fiat, returned from the United States with an assurance that Fiat was to build the North American F-86G *Sabre* all-weather fighter under licence, under off-shore orders for NATO. This is the first time a non-American firm will be entrusted with production of this top-class fighter (only licence production of the *Sabre* hitherto by Canadair). Fiat, however, is well qualified for its new task, thanks to its excellent organization and plant facilities, its long tradition in all-metal aircraft manufacture and, last but not least, to its experience in developing the *Fiat G.80* (in several versions).

It is to the credit of the Italian aircraft industry that it has not just stood by idly when faced with the vacillations of the NATO procurement offices and its own Government, but has brought out designs of its own wherever they seemed promising. For example, all the leading Italian firms are sending two-seat *military trainers* to the Show : *Fiat* the *G.49; Piaggio* its *P.150; Macchi* the *MB.323; SAI-Ing. A. Ambrosini & Co.* the all-wood *Super-7.* These aircraft will be visible in Paris either on Fiat's own *stand* or in a collective exhibit put on by the *Associazione Imprese Aeronautiche* for its member companies (aircraft, engine and equipment firms). The building of sports and executive aircraft is also given considerable attention in Italy. Visitors can expect to see the new all-metal *Piaggio P.149* in the original, while the well-known Macchi *MB.308* and *MB.320,* the *Piaggio P.136* and *P.148,* and the *Ambrosini F.4 Rondone* and *F.7 Falco* (both designed by Stelio Frati) will

Fiat's Aeritalia aircraft factory, Turin.

be there only in model form. Fiat will also show models of historical equipment.

Besides these, two little-known *new designs* will be encountered, the *SAI-Ing. A. Ambrosini & Co.* is presenting the mock-up of the



Three-view drawing of the SAI-Ing. A. Ambrosini *Sagittario* all-wood research aircraft ; span 24 ft. 7½ in. ; length 30 ft. 6 in.

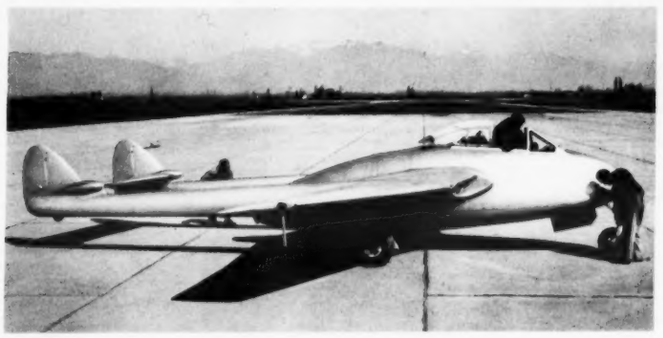
Sagittario wooden research aircraft designed by Sergio Stefanutti—with Turboméca *Marboré II* turbojet, 45° swept wing and tail-wheel undercarriage—which may serve as basic type for a light jet trainer or interceptor and features a novel arrangement of the jet power plant (in the fuselage nose with jet pipe outside). Then *Giovanni Agusta* is showing the 27-tonne *Agusta AZ.1* twin-engined turboprop airliner (with Bristol *Proteus 705*) designed by Filippo Zappata, and now in an advanced project stage—and likely to be ordered by the Italian Defence Ministry.

As for the remaining aircraft firms, *Aero Caproni Trento,* which has its F.5 two-seat jet aircraft (designed by Stelio Frati, Turboméca *Palas* engine), and *Fratelli Nardi,* with their FN-333 sports amphibian, have decided against Paris this year, so that we can only hope to find their products at the *Turin International Technics Exhibition* which is to open its doors on September 30th, 1953. The same applies to *SACA* (Società per Azioni Costruzioni Aeronavali) and *Legnami Pasotti* (F.6 *Airone* executive aircraft). However, *AERFER* at any rate will be in Paris with documents illustrating the production of aircraft spares (Republic F-84 *Thunderjet*).

Of the *engine makers, Fiat* will exhibit outstanding engines from its 45 years' experience of aero engine development, from the 50 h.p. SA 8/75 of 1908 to the turbojet. *Alfa Romeo* is showing new versions of its three well-tried in-line engines, e.g. the Alfa 110 ter (Polo) four-cylinder, the Alfa 115 ter six-cylinder and the Alfa 121 eight-cylinder engines, while *Piaggio* will have documents on the resumption of aircraft engine production (under Lycoming licence). Propellers will be shown by Fiat and Piaggio.

The Italian equipment industry is represented above all by *Magneti Marelli* (aircraft generators, magnetos, starters, spark plugs, regulators, aircraft and ground radio equipment, television transmitters, frequency-modulated R/T links, etc.), *Aerea* is showing safety harnesses and training bombs, *Aerostatica* newer models of its well-known *Salvator* parachute and rubber boats, *BBH* (Breda-Beretta-Hispano) documents on the production of airborne armament under Hispano Suiza licence, *Italia* flexible tubes, etc.—Once again the Italian industry will have an opportunity of proving its capabilities. It can now hope to have got over its greatest difficulties and look forward to taking its rightful place once more.

Italian Aircraft and Engines

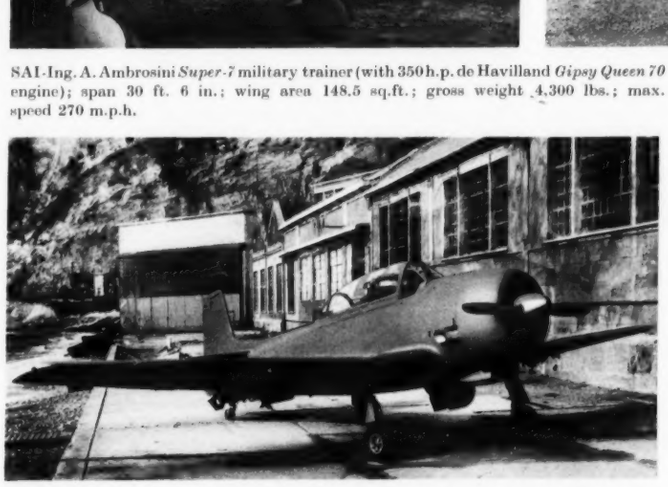


Fiat *Vampire Mk.52* (de Havilland licence). Fiat is shortly to begin licence production of the North American F-86 G *Sabre*.

Fiat G.49-2 military trainer (with 600 h.p. Pratt & Whitney R-1340 engine); span 42 ft. 8 in.; wing area 262.4 sq.ft.; gross weight 5,780 lbs.; max. speed 235 m.p.h.

SAI-Ing. A. Ambrosini *Super-7* military trainer (with 350 h.p. de Havilland *Gipsy Queen 70* engine); span 30 ft. 6 in.; wing area 148.5 sq.ft.; gross weight 4,300 lbs.; max. speed 270 m.p.h.

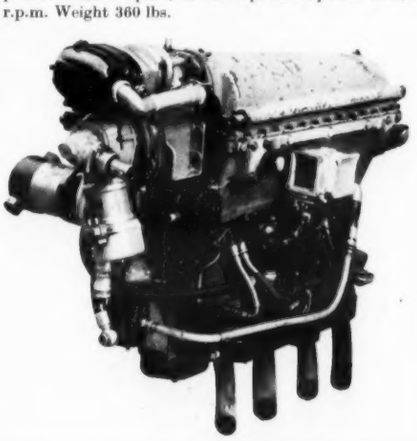
Macchi MB.323 military trainer (with 600 h.p. Pratt & Whitney R-1340 engine); span 40 ft. 8 in., wing area 237 sq.ft.; gross weight 4,960 lbs.; max. speed 230 m.p.h.



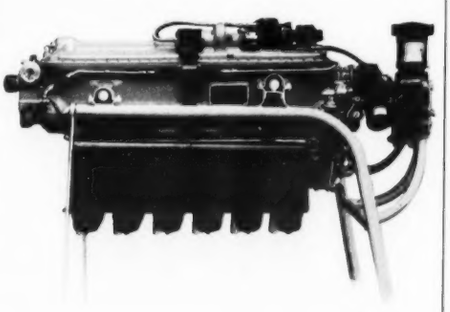
Piaggio P.150 military trainer (with 600 h.p. Pratt & Whitney R-1340 engine); span 42 ft. 4 in.; wing area 271.3 sq.ft.; gross weight 5,600 lbs.; max. speed 237 m.p.h.

Piaggio P.149 executive and communications aircraft (with 240 h.p. Lycoming GO-435 engine); span 36 ft. 1 in.; wing area 202.5 sq.ft.; gross weight 3,105 lbs.; max. speed 184 m.p.h.

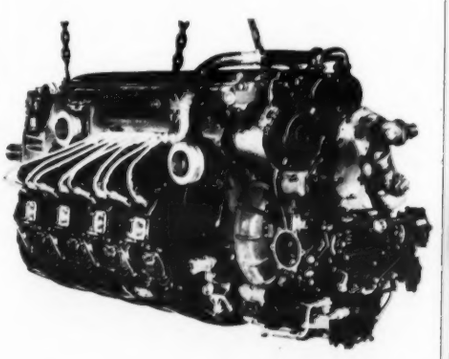
Alfa Romeo 110 ter P (Polo) engine, of 155 h.p. take-off power at 2,400 r.p.m., or 150 h.p. rated power at 2,250 r.p.m. Weight 360 lbs.

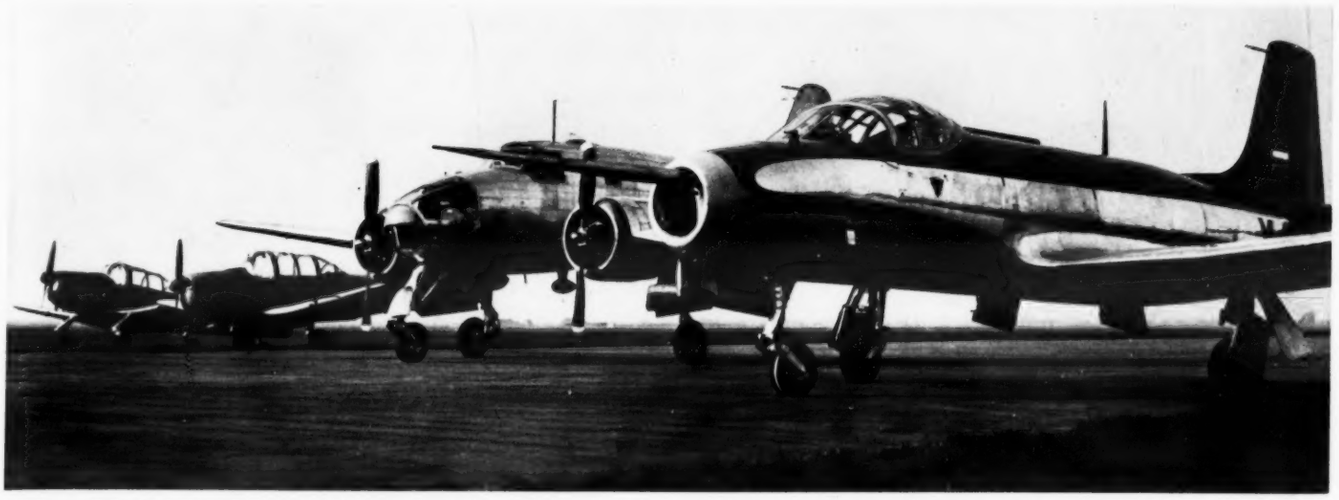


Alfa Romeo 115 ter engine, of 220 h.p. take-off power at 2,400 r.p.m., or 210 h.p. rated power at 2,250 r.p.m. Weight 514 lbs.



Alfa Romeo 121 engine, of 395 h.p. take-off power at 3,000 r.p.m., or 325 h.p. rated power at 3,000 r.p.m. Weight 760 lbs.





The Royal Netherlands Aircraft Factories Fokker will have a "sample collection" of successful trainers to show. Left to right : S.11 *Instructor ;* S.12 ; S.13 *Universal Trainer ;* S.14 *Mach-Trainer.*

Netherlands

This little country, so active in both air transportation and aircraft industry, will be represented by *N.V. Koninklijke Nederlandse Vliegtuigenfabriek Fokker,* who will once more bring along a "sample collection" of successful trainers, some in model form: *S.11* (with tail wheel) and *S.12* (with nose wheel) piston-engined trainers, which are in service with the air forces of the Netherlands, Italy and Israel (also built under licence by Macchi), then the *S.13* crew trainer (for conversion of pilots to multi-engined aircraft and training bomb aimers, navigators and radio operators) and the *S.14* jet-powered two-seat trainer. More than 30 years experience of aircraft building has gone into these types, and the S.14, designed especially for low wing loading and long range *(Mach-trainer)* has good prospects of being adopted as standard equipment by the NATO fighter schools. It is a low-wing monoplane of all-metal construction, with *Nene* or *Derwent* turbojet and side-by-side ejector seats.—Fokkers are also fully occupied with licence production of jet fighters (so far 300 Gloster *Meteor* twin-jets ; Hawker *Hunter* interceptors shortly) for the Netherlands and Belgian air forces. They also have a *propeller-turbine commercial transport, the Fokker F.27 Friendship* (for 28 passengers or cargo) under development ; it will be fitted with two Rolls-Royce *Dart* engines and will be shown in model form (scale 1 : 10).

Sweden

After some years' absence, Sweden is coming back to the Paris Show. *Svenska Aeroplan A.B.* is expected to demonstrate its *Saab 91 B Safir* (trainer/tourer), which is in service with the Swedish and Abyssinian air forces and a number of commercial flying schools. Visitors possibly may also see the *Saab 29* sonic jet fighter or the *Saab 32 Lansen* two-seater ground attack aircraft, and a recent version of the trusted *Saab 90 Scandia* twin-engined airliner.

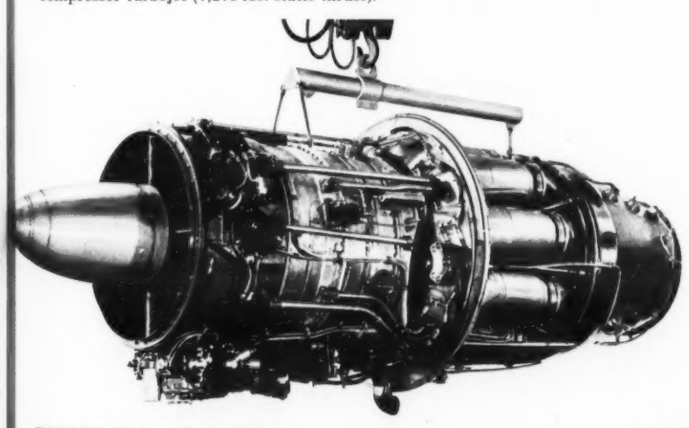
Svenska Turbinfabriks A.B. Ljungström (STAL) will be showing its new *Dovern II* axial-compressor turbojet (7,275 lbs. sea level static thrust at 7,200 r.p.m.), and *Svenska Flygmotor's* exhibit is expected to include a 160 h.p. four-cylinder horizontally opposed engine and a cut-away of its interesting gas turbine laboratory at Trollhättan.

*

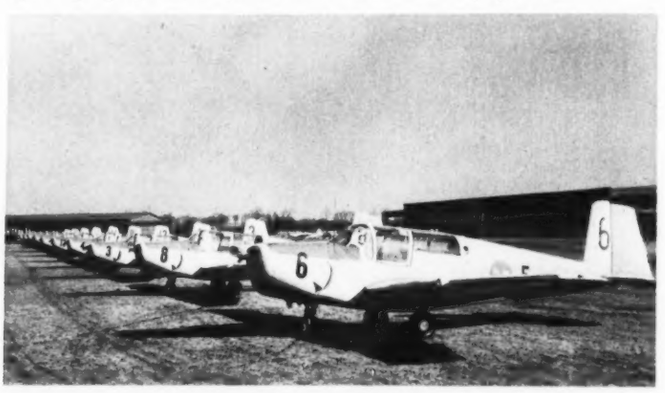
It has not been possible in the limited space available to give more than a rough outline of the non-French firms who have announced their intention of participating in the Show. Our "catalogue" of equipment to be shown makes no claim to completeness, and there may well be surprises when the Show opens.

* * *

Svenska Turbinfabriks A.B. Ljungström (STAL) is showing its new *Dovern II* axial-compressor turbojet (7,275 lbs. static thrust).



Svenska Aeroplan A.B. (SAAB) supplies its Saab 91 B *Safir* trainer/tourer (with Lycoming engine) to a number of air forces and commercial flying schools.



The British-American Jet Transport Controversy

John Wilmot, then British Minister of Supply, made the following statement in May 1946 : **British aviation, both military and commercial, will be converted entirely to jet-propelled aircraft; Britain leads the world in the development of jet-propulsion engines.**

Cyrus R. Smith, President of American Airlines, said on April 29th, 1953 : **The turbojet airplane will be fast, very fast. It is disappointing that we have no adequate proof that it can operate with economy sufficient to warrant its now being included in the operating fleet . . . The time for that is more distant than some are willing to believe.**

The two statements throw much light on the difference of opinion separating Britain's and America's experts—not as regards the feasibility of the jet transport as such but exclusively regarding the date of its entering regular commercial airline operation. High-pressure publicity has threatened to make a travesty of the problem under discussion, and it is for this reason that it can no longer be passed over in silence. Even without the tragic crash of one of BOAC's de Havilland *Comet I* airliners at Calcutta on May 2nd, the situation would have been not one wit changed, and it would be definitely premature to draw any conclusions from this accident involving a remarkable British aircraft design. To speak with Talleyrand, it would be worse than criminal, it would be stupid.

*

On May 2nd, 1952, British Overseas Airways Corporation placed the de Havilland *Comet I* in scheduled airline operation on the London-South Africa run. Needless to say, the type had been thoroughly tested beforehand by makers and operators. The publicity drum was beaten with enthusiasm, but this was not even necessary : passengers virtually crowded around the new "jetliners," all seats were sold out for months ahead. Piston-engined airliners ? The public preferred to ignore them, at least on the South Africa route.

The subject of the squabble : the de Havilland D.H.106 *Comet* four-jet transport. *Below :* model of the de Havilland *Comet III*, now in development.

Those airline operators who had no jet transports—in other words, practically all of them—began to get worried. Would they be able to stay in the running with BOAC's revolutionary new air fleet ? And for how long ? There started a kind of pilgrimage to the head offices of The de Havilland Aircraft Company Ltd. at Hatfield, and the New World's airline operators practically queued up at the door. At the head of the line was Captain Edward Vernon Rickenbacker, President of Eastern Air Lines, one of the big wheels of U.S. domestic air transportation and for many years one of Lockheed Aircraft Corporation's star customers. He was accompanied or followed by Juan Terry Trippe, President of Pan American World Airways, which calls itself the "world's most experienced airline." Canadians, French, Venezuelans, Japanese and others continued the waltz. Brazilians and others quite openly admitted that the American supplier was beginning to look a little lacklustre. Britain's industry was triumphant, and rightly so. And the British press announced that Rickenbacker wanted fifty *Comets*, Trippe about the same number. The dollar manna was about to fall.

However, most things are eaten with a pinch of salt. Rickenbacker flew back home, officially regretting that in view of the long delivery delays he had to think the matter over. Trippe, whose company likes to taste every dish that is served, finally ordered three *Comet IIIs* off the drawing board, for delivery in 1956 and acquired an option for seven more of the same model. The de Havilland sales staff has remained active ever since, the *Comet* is being demonstrated everywhere, and prospective buyers are being invited to find out for themselves what a jet transport can do.

*

What has happened in the meantime in the United States, the bastion of commercial airline operation and aircraft manufacture ? A certain restlessness is visible at every level. Has the industry been resting on its laurels, has it surrendered its leadership in the world transport market to Britain ? Why spend thousands of millions of dollars year after year if companies like Douglas, Lockheed or Boeing are not capable of building a similar or even better aircraft ? As a result, official announcements are made and points of view defined. These statements fall into three categories, inasmuch as they outline, (1) the attitude of the industry, (2) the attitude of the airline operator, (3) the attitude of the air transport authorities.

Industry

The old theory that an aircraft must be "built around" its power plant applies even more to the jet-propelled aircraft of today. Thus, the views expressed on behalf of the

world's greatest aircraft engine producer, the huge United Aircraft Corporation (and its Pratt & Whitney aircraft engine division), of East Hartford, Conn., are important. *Frederick B. Rentschler,* Chairman of the Board of United Aircraft, took time out on October 7th, 1952, to examine the case of the jet transport :

When the British Minister of Supply made his optimistic statement in May 1946, he, Rentschler, had stated he believed piston-engine transports would predominate on the world's airways until 1956. At a news conference on November 15th, 1951, he was able to point out that the first five years had then elapsed and that his forecast required no revision. Another year had passed, and, in his considered judgment, efficient heavy jet transports which would meet the requirements of American domestic and overseas routes would not be available except as prototypes before 1956. The building of a prototype transport and its translation into a production airplane so that it would be available in quantities sufficient for fleet replacement would require most of another five-year period ending in 1961. There was a clearly limited market for any type of jet air transport, efficient or otherwise, for laboratory or experimental airline operation. At this time and for the next several years, the British alone would have such an aircraft and they would experience a limited demand for it for their own purposes and for some

Frederick B. Rentschler, Chairman of the Board of United Aircraft Corporation, the world's greatest aero-engine producer, believes that jet propelled transports will not enter world-wide service before 1961.

use by certain other nations. The position provided a kind of prestige, but prestige alone was in no sense vital nor calculated to provide either present of future leadership in air transport equipment... The power plant will play a vital part in the evolution of the prototype air transport capable of meeting the requirements for fleet replacement. This power plant must display a fuel economy far superior to that of any now in operational use... At this time, both in thrust and fuel economy, advanced American jet-turbine power plants were definitely ahead of any foreign competitor, including the British.—Proud words.

The airline operator

His attitude is based on two considerations, one economic, the other technical. Cyrus R. Smith, President of American Airlines, largest U.S. domestic air transport company, and

Captain Sir Geoffrey de Havilland, founder of the company that built the world's first jet transport.

William Littlewood, his Vice-President in charge of Engineering, are well qualified to express the operator's point of view. Of interest in this connection may be the difference between modern piston-engined types and jet-propelled transports in payload percentage of gross weight under approximately equivalent operating conditions. In the four-engined Douglas DC-6B or Lockheed 1049-C *Super Constellation* payload amounts to between 20 and 25 percent of gross weight ; in the four-jet *D.H. Comet IA* the corresponding value is only 8 percent and in the *D.H. Comet III,* which is to be available from 1956 onwards, payload will be about 12 percent of gross weight.

What does Cyrus H. Smith have to say?

A turbojet transport of reasonable dimensions will require about 10,000 lbs. of fuel per hour of flight at 35,000-40,000 ft., the best operating altitude. It will require even more fuel at lower altitudes... The real problem is the cost of transporting such a great fuel weight... Too high a proportion of the total lift ability must go for transportation of fuel, and too little is available for revenue-producing passengers, mail and cargo. Yet, the long-range potentiality of the jet power plant is so tremendous that it would be unwise to conclude that the jet airplane will not have a permanent place in air transportation, but the time for that is more distant than some are willing to believe.

Cyrus R. Smith, President of American Airlines, says that the permanent advent of the jet airliner in air transportation is far more distant than some are willing to believe.

What does William Littlewood, the engineer, say on the subject?

The jet transport must represent no backward step in safety whatsoever. In spite of the increased risks due to higher speeds, it must offer a substantial improvement in safety. Range, reliability, fuel consumption and maintenance characteristics must still be vastly improved. First costs should not be exorbitant (a DC-6 costs about $1,000,000, a DC-7 $1,600,000; a production type jet transport is likely to cost about $3,000,000).

From the engineering point of view, Littlewood still sees several hazards which must be eliminated. These include the danger of explosive decompression at great altitude, the possibility of turbine wheel failure which might lead to the total loss of an aircraft, the inflammability of kerosene (which is not particularly safer than gasoline), landing hazards so long as no reliable thrust-reversing devices are available for braking purposes... Oddly enough, Littlewood does not mention one type of hazard which is becoming increasingly clear—the enormous gust loads on jet aircraft flying at high speed. These loads may be great enough to provoke wing failure, and one such failure may already have occurred.

Juan Terry Trippe, President of Pan American World Airways, whose company has ordered three de Havilland *Comet IIIs* for delivery in 1956, with an option on seven more.

The aviation authorities

Disregarding a variety of bureaucratic formulae which—how could it be otherwise in the USA—belong to the everyday operating tools of any Government body, it is of interest to list some of the major requirements set up by the U.S. Civil Aeronautics Administration. The British manufacturer is unable today to satisfy some of these demands in the *Comet I* and apparently unwilling to promise to meet them tomorrow in the *Comet III.* The CAA's hesitations include the following :

The British design features submerged wing installation of the jets. The Americans now seem to possess classified accident reports involving their own military aircraft which prove this type of engine installation to be hazardous, even though a turbine wheel failure may occur only once in every 200,000 engine hours, or even, the British claim, once in every 1,000,000 engine hours of flying. The CAA specifies double window

panes and doors opening outwards, to which the British object that such features would increase structural weight and further impair the aircraft's precarious economy of operation... The Americans insist on the installation of a loss-of-speed indicator, i.e., a thrust meter, to indicate drops in power (particularly in view of the take-off accidents at Rome and Karachi). Furthermore, the CAA requires complete isolation of the fuel system from the engines, mounting of shutters over the air intakes to enable the engines to be stopped.

The U.S. Airline Pilots Association, too, has spoken up with a few more technical recommendations :

Control booster systems (such as those mounted on the *Comet)* should be avoided ; alternatively "artificial control feel devices" of the kind used in large U.S. transports must be provided. Prior to putting jet transports into scheduled operation, information should be gathered concerning turbulence and gusts at great altitude, as these may place excessive loads on the structure of the aircraft, etc.

*

This is a rough outline of the U.S. attitude, of the doubts the Americans still have about placing jet-propelled commercial aircraft in regular service at this time. While the British have inaugurated commercial jet operations, the Americans propose to wait and employ jets only when they can meet certain conditions. These differences of opinion have provoked the present controversy between American and British aviation circles. An agreement on the principles underlying the American requirements is now being negotiated.

Captain Edward Vernon Rickenbacker, President of Eastern Air Lines, started negotiations at The de Havilland Aircraft Co.'s headquarters at Hatfield, Herts., but decided against buying because of the long delivery delays.

It should not be overlooked that the Americans can afford to study the problem with some measure of detachment, since for the time being no industrial or operational interests are involved. The British, on the other hand, are showing a certain amount of temperament in their arguments, since the controversy affects their prestige, their aircraft industry and their commercial airline interests.

When World War II came to an end, Britain's aircraft industry was faced with two alternatives : to do or die. For years it had led the field in the production of fighters and Rolls-Royce liquid-cooled engines, and it had concentrated all its resources on the war effort. In the production of multi-engined bombers its activity had been satisfactory but not brilliant, but in transport aircraft design and development—no Briton will quarrel with this—it had failed. Now the war was finished, and the pre-war lag had to be made good. And to make it good it was not enough to advance gradually along a conventional line of evolution : it was decided to jump a stage or two and ring in a new epoch. Courageously The de Havilland Aircraft Co., Ltd., designed and built the *Comet,* the world's first jet-propelled airliner, a showpiece among British aircraft.

A shrewd look at this "controversy" shows, however, that the two nations, both of them deeply engaged in world-wide air transportation, in reality are arguing about two entirely separate matters : the British about the de Havilland *Comet,* which is in existence and in operation on the Commonwealth air routes ; the Americans about the type of jet transport which will not predominate in world air transportation until tomorrow.

E. E. H.

Those "Off-Shore" Contracts

An "aircraft production fund" in the total amount of $559,540,000 was established—in theory at least—by the North Atlantic Treaty Organization in Paris on April 23rd. On that day the Defence Ministers of the USA, Great Britain, France, Belgium and Holland, who were attending the spring sessions of the NATO Council, signed aircraft procurement agreements settling the problem of American "off-shore" aircraft purchases which had been the subject of both intelligent and fanciful guesswork for many weeks. These agreements have still to be ratified by the parliaments of several of the European partners.

What is the principle underlying off-shore procurement ? To the man in the street, the term means briefly that the United States, instead of paying out money to American factories for equipment destined for its European Allies or even for its own use, is paying foreign manufacturers to relieve the work load on American factories.

That the problem is not quite as simple is evident from the fact that the contracts signed in April, however large they may seem, are a mere drop in the bucket compared with the total production contracts now being handled by the U.S. aircraft industry. It is obvious that American manufacturers could take this additional production in their stride. The contracts imply another element, namely, that of aid to America's Allies. This element was pertinently analysed in the French Air Ministry's Information Bulletin at the beginning of last month, which distinguishes three classes of off-shore purchase :

1. The equipment ordered is destined for the U.S. armed forces. In this case, the producing country receives economic aid through the work provided for its industry and through the American dollar payments.

2. The equipment ordered is handed over free of charge to the armed forces of the country producing it. Economic aid is then accompanied by military aid.

3. The equipment ordered is destined for a NATO nation other than the USA or the country producing it. In this case, economic aid is similar in effect to that in the first two cases but takes the form of hard-currency exports, since payment is made in dollars even if the equipment goes to a soft-currency country.

Contracts are concluded between the U.S. Government and the Governments of producing countries, or awarded direct to individual manufacturers. The Paris purchase agreements of last April were signed between Governments, and it is the individual receiving Governments that will pass on the actual production contracts to the manufacturers. Furthermore, off-shore contracts are not necessarily limited to NATO countries : several American orders (not for aircraft) have previously been placed with German and Japanese firms.

Now the Americans are hard-headed businessmen and seem to be growing even harder-headed under the new Eisenhower Administration. The U.S. off-shore contracts are subjected to keen Congressional scrutiny, with the result that negotiations are often very laborious. Actual purchases are usually financed by the Mutual Security Agency (MSA) when the equipment is destined for a NATO country ; the U.S. Army, Navy and Air Force finance purchases from their budget appropriations if they are intended for their own use—an arrangement which is quite flexible, as will be seen. Prices are very carefully examined and must be exempt from national taxation which must be covered by the military budgets of the producing country. In the case of France, for example, taxes on aircraft production orders amount to about 20 percent of the contract

value, and these taxes are payable out of France's own budget—after all, it seems comprehensible that the Americans should refuse to become French taxpayers.

These hard-headed American businessmen have also devised certain rigid rules which NATO member nations must meet to qualify for the contracts. The most important stipulation is the one governing what the British have come to call *"quid-pro-quo" contracts*. This means that in order to get an American off-shore order, a country has to undertake to finance additional orders from its own budgetary resources. Thus, of the total aircraft production "fund" of $559,540,000 mentioned at the beginning, $281,540,000 represents American off-shore orders, while $278,000,000 takes the form of "quid-pro-quo" contracts—approximately a "fifty-fifty" arrangement.

Another rule—and this is regarded as an irksome restriction by some of the European partners—specifies that the recipients of American off-shore orders are not free to do what they like with the dollars they get for their work. The money remains blocked and must be used in the USA to buy products of prime necessity to the manufacturing country's national economy.

One reason for the long delay in the signing of the Paris off-shore purchase contracts has been purely legislative. The $281,540,000 expenditure to which the U.S. has committed itself comes out of the U.S. budgetary Mutual Security Agency appropriations for the 1953 fiscal year which ends on June 30th. The money was to be spent for *equipment to be delivered within two years,* i.e. before July 1st, 1955. It was clear from the beginning that the European factories would be unable to meet this deadline, since some of the manufacturers involved have not even tooled up or are only just beginning to tool up for the quantity production of the aircraft types chosen. What happened in Paris is that an intelligent U.S. officer finally found a loophole to get around the obstacle of the July 1st, 1955, deadline. This loophole is the transfer of the MSA money to the U.S. Air Force—the latter is doing the actual buying, and the delivery deadline has been loosely extended to July 1st, 1956. How well Europe will work without the urgency of a "now-or-never" delivery date remains to be seen.

The table on this page contains the details available of the procurement agreements signed in Paris, including U.S. dollar contracts and "quid-pro-quo" contracts. It is not complete, since in some cases the number of aircraft ordered is not known and because it *contains no details of the production contract now being negotiated between the USA and Italy.*

As is known, Italy's well-developed aircraft industry was expected to come in for a major share of the U.S. off-shore contract awards. The fact that no firm agreement was signed with the Italians seems to have been due chiefly to technical reasons—namely, the choice of the aircraft type to be built. The only point on which the experts had long been unanimous was that Italy should produce an all-weather fighter, which was lacking in the off-shore panoply. The Paris announcement of last April that the Italo-American negotiations involved the North American F-86 D *Sabre* all-weather fighter has now put a stop to earlier conjecture. As is known, the Italian industry had been preparing to go ahead with the production of the de Havilland *Venom* all-weather fighter, admittedly an obsolescent type. Subsequently it transpired that the Gloster *Javelin* twin-jet delta-wing fighter was the most likely candidate, but this has now been dropped in favour of the single-engined *Sabre*. The reason for this decision no doubt was the high cost and complexity of the twin-jet *Javelin*. The British are hoping that the question of *Javelin* production will be raised again under the (much reduced) 1953-54 dollar funds, but it seems unlikely that the Americans will approve of a "change of horses in mid-stream."

The amount of money the Americans propose to invest in Italian *Sabre* production has not been announced ($26,000,000 had previously been mentioned for the *Javelin,* but this figure seems to be too modest). Nor is it known if the Italian Government will be expected to order *Sabres* or other types under "quid-pro-quo" appropriations. Finally, it is unknown if U.S. off-shore orders will be limited to all-weather fighters or whether they will include other aircraft, such as trainers.

To begin with, the Italian aircraft industry will assemble *Sabres* from components made in the USA, and the first of these were expected in Italy in May. Later on, the Italian factory (or factories) in question will be authorized to manufacture parts for the aircraft and also for its General Electric J-47-GE-17 turbojet engine. Ultimately the whole airframe and engine and some of the equipment may be built in Italy. This plan constitutes a certain *volte-face* on the part of the U.S. defence authorities, who so far have rejected all plans to have any recent U.S. combat type built abroad.

A little-known angle on the situation is that the F-86Ds to be assembled and later built in Italy will be USAF property and that at present *North American Aviation Inc.* will have no proprietary rights in the aircraft and can receive no royalties or licence fees. This is because all design development was U.S. Government financed. There is no doubt, however, that some formula will be developed to give North American some sort of payment, in parallel to payments that may be made to Hawkers in respect of the *Hunter*. The method to be employed is still a mystery.

Altogether the 1952-53 U.S. off-shore contracts call for approximately 1,000 fighters. All of them will be U.S. property and they will not necessarily be given to the air forces of the countries producing them (France, Holland, Belgium, Britain).

Regarding the aircraft listed in the table, it is almost certain that some of the British-built off-shore *Hunters* will go to other air forces, chiefly the future German air force. The same may apply to those built by Fokkers (Holland) and the *Avon R.A.7* engines to be built by Fabrique Nationale (Belgium). The 100 British-built *Sea Hawks,* on the other hand, will go to strengthen the Royal Navy's anaemic carrier fighter arm. The 215 British "quid-pro-quo" *Swifts* will go to the RAF, whereas the 225 off-shore *Mystères* (the price of which includes expenditure for tooling) will no doubt be delivered to the French Air Force, possibly also the 150-plus "quid-pro-quo" *Mystères* (production of which is financed not through off-shore but U.S. economic aid funds). The type of aircraft to be built under the Belgian-Dutch "quid-pro-quo" orders—possibly partly financed by U.S. economic aid—has not been definitely chosen, and both the *Hunter* and the *Mystère IV* have been mentioned. It is most likely, however, that upon completing the 100 off-shore *Hunters* Fokkers will go on producing the same type rather than switch over to a different, though equivalent model.

A significant feature of these agreements is that they call for production of fighter types only. This obviously means that the USAF is confident of its ability to shoulder the major portion of or even the whole burden of strategic bombing in the event of another war.

NATO military leaders have welcomed the announcement as a major step towards the establishment of a broader defensive aircraft production basis in Europe. Should an emergency arise after 1956, Europe will not only have a substantial number of first-class combat aircraft in squadron service but also the facilities to turn out more equipment at a rapid rate.

U.S. orders				*"Quid-pro-quo" orders*		
Country	*Type*	*Number*	*Amount*	*Type*	*Number*	*$-Equivalent*
Britain	Hunter F.1 Sea Hawk	450 100	$140,000,000 $13,000,000	Swift	215 *	$70,000,000
France	Mystère IV	125 by June 30, '55 100 by June 30, '56	$86,540,000	Mystère II Mystère IV	150 n.a.	$108,000,000 **
Netherlands	Hunter	100 *	$18,000,000	Hunter	n.a.	$10,000,000
Belgium	Avon R.A.7 engines	150 *	$24,000,000			
Italy	Sabre F-86D	n.a.	n.a.	n.a.	n.a.	n.a.
Totals (mid-May): *U.S. Off-shore orders*			$281,540,000	*Quid-pro-quo orders*		$278,000,000
Grand total			$559,540,000			

* Unconfirmed. ** Financed through U.S. economic aid funds.

Planes for Payload

The Evolution of Fairchild's Cargo Transports

In the early phases of World War II, Hitler made the dream of an airborne and air-supplied army a reality with his blitz invasions of Norway, the Lowlands and Crete. His most effective instrument in this was not a sleek, super-streamlined airliner, but the rugged and economical Junkers Ju 52 three-engined transport. This ship had a cargo capacity of only about two tons, but it was effective because it was low-slung and easy to load. Cheap and quick to produce, Ju 52s were turned out in large numbers for the Nazi invaders. Some 200 were used in the air-supply of Hitler's Stalingrad operation alone. Had there been more, history might well have been changed.

Experience with this airplane proved for all time that the performance requirements and configuration of a civil passenger transport and a military cargo plane were, and are, far from identical, just as a freight train bears little resemblance to one of those American transcontinental luxury passenger trains. As a result of lessons learned in the operation of personnel transports as cargo aircraft, certain fundamental characteristics of cargo craft began to emerge.

Because the primary purpose of the military cargo aircraft was to deliver heavy and bulky articles, it was evident that the configuration of the cargo hold should receive top consideration in any new design.

The only way to provide for flexibility of loads was to design for the most restrictive load, both dimension-wise and weight-wise. The U.S. Army's largest wheeled vehicles, therefore, served as the index. Straight-in loading through easily operated rear doors became a necessary design factor. This feature was to prove a great boon for the general run of military cargo, the bulk of which is actually not vehicles but an assortment of general items of all shapes, sizes, and weights.

The idea interested the U.S. Army Air Forces during World War II, especially if the plane could be built of wood rather than of critically short aluminium. The Materiel Command granted permission to *Fairchild Engine & Airplane Corp.*, of Hagerstown, Maryland, to build a wooden mock-up. This was finished in September 1942.

After inspection by the USAAF and approval of the design for construction, a contract was awarded to build two C-82 prototypes and a static test model.

As work on these plans progressed, it became increasingly evident that wood was not entirely practical, and that an all-wood cargo airplane would not do the job the Army and Air Forces wanted. Little by little, aluminium replaced wood in the prototype, until finally the only thing made of wood was part of the navigator's table.

The C-82 *Packet* took to the air for its first flight in September, 1944. Success of the early tests led the USAAF to award a production contract to Fairchild, calling for a hundred C-82 *Packets*. A production contract was also awarded to North American Aviation's Dallas plant for 700 ships. Both companies started production in January 1945; Fairchild completed its first production aircraft by May, North American by August.

This then new and unusual aircraft, with a wing span of 106 feet and overall length of nearly 76 feet, weighed more than 26,500 lbs. empty and had a gross weight of 42,000 lbs. In design, it was unlike anything ever seen in the air, for Fairchild had produced what was then called "a boxcar with wings." Through the gaping maw of the unique clam-shell cargo doors at the rear of the fuselage, the Army could drive many of its wheeled vehicles into a cavernous hold 38 feet long. Some 28 feet of this hold was eight feet high and eight feet wide. Total cargo capacity was 2,916 cubic feet. To facilitate loading and unloading on the ground, the cargo deck was located at standard truck-bed height, reducing the need for special handling equipment. Because the ship was end-loading, articles which formerly had been disassembled for shipment could be taken aboard in one piece.

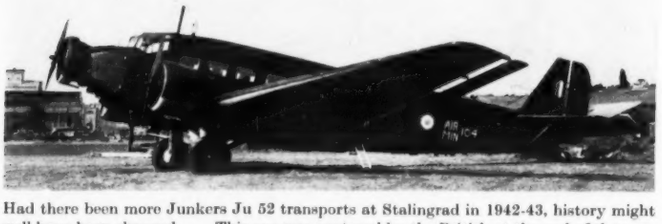
Experience of the Army by then had indicated that a cargo plane could not always land in forward areas to deliver its load. Like the German troops in the Stalingrad push and the United Nations' so often in Korea, many combat units could be supplied most effectively by "paradrop." Provision was made so that the clam-shell doors of the C-82 could be left at the base, and almost any cargo in the hold could be kicked overboard, attached to parachutes. In addition, the aircraft was built to carry 42 fully equipped paratroops or 34 litter patients and four medical attendants.

When C-82 production started, it had been planned that the new aircraft should support the invasion of the Japanese main islands by hauling in paratroopers and combat cargo and by evacuating the wounded. The *Packets* were to operate from Okinawa, carrying some 12,000 pounds about 2,000 miles to Japan.

While the *Packets* never got into action during World War II, the troop and cargo experience gained from this plane crystallized into certain basic laws governing military air transport. The *Packet* proved to have a configuration which permitted the widest possible travel of the center of load, an essential quality because cargo loading under combat conditions frequently is hasty and far from scientific.

The advent of VJ-Day meant contract cancellations throughout the aircraft industry, and the North American contract for the *Packet* was annulled. Fairchild itself was not seriously affected by the armistice. The company had even been promised a contract for another 100 *Packets* and received this renewal after VJ-Day. Production continued through 1946, 1947 and 1948, when a total of 222 *Packets* had been built, including the two prototypes.

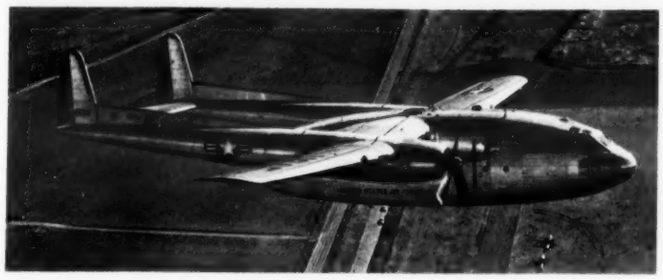
Fairchild C-82s had their first real chance to show their stuff in June, 1948, when the Russians threw a blockade around Berlin in an effort to strangle the German capital and force the Allies to abandon it. Five *Packets* from the 60th Troop Carrier Group, at Wiesbaden Air Force



Had there been more Junkers Ju 52 transports at Stalingrad in 1942-43, history might well have been changed . . . This one was captured by the British at the end of the war. (British Crown Copyright.)

One of the Fairchild C-82 A *Packets*, first production type.

Paratroops tumbling out of a C-119B *Flying Boxcar*.



The C-119C *Flying Boxcar* had extended dorsal fins along the booms.

Base in Germany, were pressed into service in the round-the-clock airlift, which soon became known as "Operation Vittles." These freighters flew the narrow supply corridor in and out of Berlin's Tempelhof airport, hauling the heavy, odd-sized cargo that would not fit in the C-54s. "Operation Vittles" saw the C-82s handle such varied cargoes as cranes, tractors, rock crushing equipment, earth graders, jeeps, aircraft engines, heavy generating plants, dump trucks, steam rollers, ambulances, snow plows, fuel-servicing units, cement mixers and steam shovels.

As dramatic and successful as were these operations, the practical testing of the *Packet* also disclosed suggested improvements in the aircraft, and these were already being incorporated in the design and blueprints of a worthy successor, the C-119 *Flying Boxcar*.

Two years of operation and training with the *Packet* had disclosed, for example, that forward and downward vision should be improved for greater drop accuracy. The necessity of pinpointing paradrops of troops and supplies into small drop zones made it expedient to move the flight deck in the C-119 forward and down. Demands on the military for even greater load lifting ability and cargo capacity than the C-82 possessed also indicated the utility of greater engine power and a larger hold.

Thus, the C-119A was born by diverting one of the last C-82s on the production line and modifying it in line with the dictates of experience. The Air Force quickly accepted this new version of the *Packet*, and, when the C-82 contract was concluded late in 1948, Fairchild received a contract calling for the production of 37 *Flying Boxcars* designated as C-119Bs. This model featured a cargo space 14 inches wider than that of the C-82s, increasing the cargo capacity by 179 cubic feet to 3,095 cubic feet.

The Marine Corps, as well as the Army and Air Force, soon recognized the unique potentialities of an aircraft of this type in USMC operations. The Navy Department obtained eight of the original *Packets* and designated the type the R-4Q1. In 1949, the first Air Force order for 37 was followed by another contract calling for an additional 99 C-119Bs.

While the early C-119s were on the production line, Fairchild designers were busy on another revolutionary airplane which would present great

The detachable pod of the Fairchild XC-120 *Pack Plane* opened new vistas for military and civil cargo transport.

One of the most unusual features of the *Pack Plane* is the fact that it can fly even without its pod.

potentials to the military. This was the XC-120 *Pack Plane*, designed on the detachable cargo compartment principle so that a parent plane might change compartments as easily as a highway tractor switches trailers.

Fairchild's Cargo Family

Type	Year	Engines (2)	Span	Length	Weights (lb.) Empty	Weights (lb.) Gross	Top Speed m.p.h.
XC-82 *Packet* (Prototype)	1944	P&W R-2800-22 2100 h.p. t.o.	106′ 6″	75′ 10″	26,530	42,000	220
C-82A *Packet* (Prod. Model)	1945	P&W R-2800-85 2100 h.p. t.o.	106′ 6″	77′ 1″	31,300	54,000	248
C-119A *Flying Boxcar* (Prot., modified C-82A)	1947	P&W R-4360-20 3250 h.p. t.o.	106′ 6″	85′ 10″	34,150	64,000	231
C-119B *Flying Boxcar* (Prod. Model, wider Fuselage)	1948	P&W R-4360-20W 3250 h.p. t.o.	109′ 3¼″	86′ 6″	37,230	71,800	266
XC-120 *Pack Plane* (Detachable pod)	1949	P&W R-4360-20 3250 h.p. t.o.	109′ 3¼″	83′ 0″	44,200	73,700	258
C-119C *Flying Boxcar* (Extended fins)	1950	P&W R-4360-20WA 3500 h.p. t.o. water injection	109′ 3¼″	86′ 6″	39,830	73,150	290
C-119D *Flying Boxcar* (Detachable pod, not built)	1951	P&W R-4360-20WA 3500 h.p. t.o.	109′ 3¼″	86′ 6″	41,000	70,700	260
YC-119E *Flying Boxcar* (C-119H *Skyvan* predecessor, not built)	1951	Wright R-3350-30WA 3500 h.p. t.o.	148′ 0″	95′ 8½″	41,400	72,500	262
C-119F *Flying Boxcar* (Similar to C-119C)	1952	Wright R-3350-85 turbo-compound 3500 h.p. t.o.	109′ 3¼″	86′ 6″	37,950	73,150	290
C-119G *Flying Boxcar* (Aeroproducts propellers, prototype only)	1952	Wright R-3350-85 3500 h.p. t.o.	109′ 3¼″	86′ 6″	38,100	74,400	288
C-119H *Skyvan* (New wing, booms, tail surfaces)	1952	Wright R-3350-85 turbo-compound 3500 h.p. t.o.	148′ 0″	95′ 8½″	46,450	85,900	264

Fairchild has developed a "roadable" pod for the XC-120. V-shaped fairings are added fore and aft to reduce drag in flight.

The XC-120 was primarily a C-119B—with one major difference. The bottom two-thirds of the cargo fuselage actually was a separate unit, which could be detached from the top section and hauled away. The plane could also fly without the cargo pod. Two Pratt & Whitney R-4360-20W engines of 3,500 horsepower each gave the *Pack Plane* a take-off gross weight of nearly 74,000 pounds and a 1,500-nautical-mile range with a 10,500-pound load. During the past year, Fairchild has built and tested two different pods for the XC-120, including a "roadable pack" which can be towed over the highway like a standard freight trailer, rolling on conventional truck-type wheels on even secondary roads.

This airplane has been hailed as an entirely new concept in air transportation, for the principle of the detachable fuselage may offer the first real answer to many of the most pressing problems of military logistics. Fairchild engineers also have designed this unit with an eye on possible civil applications. With its truck-type wheel assemblies, the pack can be towed to an airport and attached to a mother ship, ready for delivery anywhere within the airplane's cruising range.

While the XC-120 was under development, the Army and Air Force were putting C-119s to the test for further evidence of what the *Boxcars* could do under combat conditions. As a result, planning for future military operations took on more and more of a trend toward air transportability.

The future was not long in coming. In June of 1950, North Korean troops marched over the 38th Parallel and invaded South Korea. This placed squarely before the Air Force the task of quickly moving troops, supplies, and equipment into the actual combat zone. Under a rush order from the Air Force, the Hagerstown plant began modifying C-119s for long-range operations. Thirty-six C-119s just assigned to the 314th Troop Carrier Wing at Sewart Air Force Base were called back to the Fairchild plant, fitted out with 1,000-gallon auxiliary fuel tanks inside their cargo holds, and sent winging across the Pacific. By mid-September, these planes were flying urgently-needed supplies and equipment into Korea from combat cargo bases in Japan. By year end, 100 C-119s were operating in the Combat Cargo Command.

This Far Eastern service pointed to the need for increasing wing surface, a factor which would permit shorter landing and take-off distances and slower landing speeds, as well as greater payload. Since the first appearance of the XC-82, wingspan of *Flying Boxcars* had remained about 106 to 109 feet, and empty weights had risen from 26,530 pounds for the XC-82 to 39,830 pounds for the C-119C. Wing design, too, had remained fairly constant, adhering to a NACA 2418 root profile and a NACA 4409 tip profile with straight taper.

Latest addition to the Fairchild cargo transport family is the C-119H *Skyvan*, derived from the *Flying Boxcar*.

Late in 1951, Fairchild received permission to take a C-119 from the assembly line and convert it into a new airplane to be known as the C-119H *Skyvan*. Modification was started, and by last Spring, the "H" was ready for flight testing. While the basic designation was the same, the *Skyvan* was so vastly different from its predecessors that it was virtually an entirely new version of the C-119. It had a new wing of completely different design, a wing that offered some 40 percent more surface. The designer, Chief Engineer Walter Tydon, had stressed simplicity of design and manufacture in the "H." The new wing's center section lacked dihedral, anhedral, taper, and twist. The big change in wing design and size called for alterations in the empennage, and the tail surfaces were modified accordingly. Longer booms gave the *Skyvan* an overall length of more than 95 feet, as opposed to the previous length of 86 feet.

Probably the most noteworthy difference between the "H" and earlier C-119s was the new application of external fuel tanks. Heretofore, all fuel had been carried in internal wing cells, with their maze of piping, interconnects and control devices. Instead, this new airplane carried all of its fuel in two pods mounted beneath the wing outboard of the nacelles. This, Fairchild's first use of external fuel supply, presents several distinct advantages over previous systems. Refuelling and servicing are greatly facilitated, because the tanks are readily accessible. Tanks may be replaced in the field, thereby cutting maintenance and overhaul time. Despite the fact that they are exposed, they present less than half the area of internal cells in the event of gunfire. From the standpoint of safety, the external pods also offer increased safety to crewmen. In case of fire, danger is isolated and is confined to the slipstream which presents a barrier between the blaze and the crew. In the event of a crash landing, the tanks will rip off easily, cutting the chances of the fire reaching either crewmen or the plane itself.

Power for this prototype C-119H is furnished by two Wright R-3350-85 turbo-compound engines of 3,500 horsepower each. The plane has a design gross weight of 80,780 pounds and a maximum gross take-off weight of 85,900 pounds.

The *Skyvan* made its first flight on May 27th, 1952, and its flight-testing program showed that it was even better than expected. At normal gross weight, the "H" can take off and clear a 50-foot obstruction in less than 2,300 feet, and land over the same obstruction within less than 1,750 feet. For the aerial delivery of personnel and cargo, the plane can slow to a speed of less than 70 knots, amazingly low for an aircraft of this size.

Fairchild's "trucks of the air" have opened new horizons for tacticians. Today they form the backbone of a new instrument, born out of a war, but with an as yet incalculable civilian future—the airlift. In parts of the world where roads and other means of human communication are few and far between, cargo aircraft have enabled transportation to take the big jump from horses to airplanes. Each day, the press is filled with dramatic incidents. Moslem pilgrims are airlifted to Mecca. Cattle are hauled from the Australian outlands to urban markets. Iron mining equipment is borne by air into the wilds of Canada. All these miracles have come to pass in the short period that is now being commemorated as the first 50 years of powered flight.

Accepting the adage that what is past is prologue, the story of the *Flying Boxcar* would offer its own clues. In years to come, when military demands are no longer preemptive, Fairchild can be counted upon to provide, for the use of a world at peace, modern planes built for payload.

"Flying Artillery" in the Light of the Korean War

BY MAJOR EDDY BAUER, PROFESSOR, UNIVERSITY OF NEUCHATEL

Is the value of tactical air power on the wane ? This question is seriously being asked in aviation circles in spite of the outstanding results it produced between September 1939 and August 1945 in all of World War II's theatres of operations.

Both in his fascinating book on the lessons of the Korean war [1] and in a recent article in "Revue de la Défence Nationale,"[2] Camille Rougeron, well-known French military critic, asserts that, indeed, tactical air power is on the decline. In support of this seemingly paradoxical contention, Mr. Rougeron, who is fully acquainted with all modern technical advances, calls on the authority of General Alfred Gruenther. Had not SHAPE's Chief of Staff stated in September 1952 that the lesson of the war in Korea was the triumph of the infantry, that the Communists had held out for two years without aircraft worth mentioning, despite the United Nations' crushing superiority in the air ? And shortly before he was transferred to Europe, General Matthew Bunker Ridgway, Supreme Allied Commander in Europe, made the disconcerting admission that the Sino-Korean command had been able to keep up supplies for the war of attrition that has been fought around the 38th parallel for eighteen months, in spite of continued United Nations air superiority over the front and the immediate rear areas.

On August 18th, 1951, Tokyo headquarters launched "Operation Strangle" against enemy communications, using aircraft of the 5th Air Force and warships of the 7th Fleet. H.Q. has since admitted that neither bombs nor shells, dropped and fired in their thousands on all the soft spots in North Korea's rail and road network, have yet prevented the enemy from moving, relieving and supplying his divisions.

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One thing that needs no proof is that tactical air forces have been greatly developed and improved since the days of their lightning blows on the battlefields of Normandy and the Ardennes. The close support air units have converted from the P.47 *Thunderbolt* to the F-84 *Thunderjet*. Moreover, air-ground communications have today acquired a precision that would have been regarded as impossible on the morrow of the landings in Normandy. Ground support missions enable the tactical air force to back up the infantry as effectively and as closely as did the best-trained artillery of the two world wars. On the defensive, too, we have seen Marine Corps units operate under conditions in which the most intrepid of artillerymen would at one time have called quits. In August 1950 we saw them disperse with their airborne armament the Communist assault waves reaching to within 20 yards of the American positions.

The specialised equipment of fighter-bombers for intervention in the ground fighting has made no less sensational progress in the past ten years. Examples are :

1. The napalm container ; it was first tested by the Americans during the assault on Tinian in the Marianas Group (end of June 1944) [3], then employed occasionally during the last phase of the war. Widespread use has been made of it in the Korean war, both against personnel and against equipment, in particular tanks. In 58 days of operation, between February 22nd and May 21st, 1951, to take a single limited period (which, however, includes the two Sino-Korean "spring offensives"), American tactical units dropped no less than 2,500,000 U.S. gallons of napalm, or between 30,000 and 40,000 containers.

Ground support pilot after completed mission : First Lieutenant Emory E. Hodges (of Leaksville, North Carolina) leaving the cockpit of his F-80 *Shooting Star* on returning from a strafing mission against North Korean troops in an orchard . . .

. . . The *F-80 is then immediately taken over by the ground crew* and armed with rockets for its next mission.

[1] Published by Berger Levrault, Paris, 1952.

[2] Volume 9, January 1953, pp. 16-36 : *Le Déclin de l'Aviation tactique.*

[3] Fletcher Pratt : The reconquest of the Pacific by the U.S. Marines (1943-45).

2. The 500-lb. fragmentation bombs detonated a few feet above the ground by means of a proximity fuse. Simple cover and trenches no longer suffice to protect troops from this new weapon, as the splinters fall at an almost vertical angle over a fairly large area. Unless the troops bury themselves in foxholes, they will suffer frightful casualties. Camille Rougeron quotes an example in which American infantry found 800 Chinese killed and wounded on the slopes of a hill which had been plastered with this kind of bomb by a single *Superfortress*.[4]

3. Rockets. These had of course been known since the battle of Normandy and especially since the catastrophic effects they had had on the Panzers during the mad counter-attack launched at Mortain early in August 1944 by von Kluge at Hitler's express command. Today they are to be found in all calibres from 3.2 to 12 inches *(Tiny Tim)*; with hollow charges, they got the better of the North Korean tanks during the first phase of the campaign ; they have since been used with similar success against road and rail transport. According to American figures more than 563,000 rockets had been fired in Korea in the 33 months up to the writing of these lines, compared with 219,000 between Pearl Harbor and the final capitulation of Japan (44 months).

*

If therefore we had to accept it as proved that the "flying artillery" has failed in Korea, in spite of the considerable improvements to its equipment and weapons, the outlook for NATO's forces, if ever they were called upon to defend Western Europe against aggression from the Eastern *bloc,* would indeed be bleak. Inferior in numbers and in ground equipment, their fate in the event of war would be to succumb in several isolated pockets to the crushing weight of Marshal Bulganin's armour and artillery divisions. They might hold out for a time, but sooner or later the unequal struggle would come to its inevitable end.

[4] Op. cit. p. 156 —A *Superfortress* carries 40 of these bombs.

Aircraft of the U.S. Navy also intervene in support of the ground fighting. A "veteran" Chance Vought F4U *Corsair* taking off for the 38th Parallel from an American aircraft carrier.

The U.S. Navy's "flying artillery" has repeatedly intervened in situations where even the toughest artilleryman would have called quits.

We must admit that for our part, we cannot subscribe in full to such radical opinions. But let us make ourselves clear. We do not wish to set ourselves up against the views of Generals Gruenther and Ridgway, or to undertake to refute Camille Rougeron's arguments. Such audacity would merely make us look ridiculous. We should simply like to extenuate a little their seemingly harsh verdicts on the effectiveness of tactical air power, or better still to define the limits within which these verdicts hold good.

It is quite true that the flying artillery has not been able to gain for the U.S. 8th Army the decisive advantage which it had hoped for. To the east, north and west of Chorwon, fighting has been going on with unequalled fury since the beginning of summer 1951 for possession of the "Punchbowl," "Heartbreak Heights," the "T-bone" and the "Pork Chop," but the weight of the tactical air units has not been able to tip the scales in favour of the Americans, or at any rate to any marked degree.

This state of affairs has its explanations. The campaign in Italy during the winter of 1943-44 had already shown that bombing loses most of its effectiveness in mountainous country, especially as the infantry find it difficult to take immediate advantage of its powerful psychological effect, and tanks get out of breath on the slopes. It must also be remembered that General Van Fleet, then commanding the 8th Army, never had more than seven American divisions on the Korean front, which obviously limited his scope. Finally, the average daily sorties on the Korean front can in no way compare with what was seen on the Western front in 1944 and 1945, namely less than 1,200 sorties, including those by strategic units, along the whole of the front and in depth. This compares with 3,000 sorties on July 24th, 1944, where the American 7th Corps was making its decisive attack.

However, we think the Chinese and North Koreans have been cleverer than the Germans in organizing their defensive positions and that they have thus rendered their opponents' air power more or less ineffective. Their field fortifications comprise innumerable bunkers,

each with several exits. Doubtless they are not proof against a direct hit by a heavy bomb. However, with the aid of camouflage which has frequently been admired by the Americans they can be hidden much more effectively from ground or air observation than any of the concrete emplacements in the Siegfried or Maginot Lines. Their numerous exits both front and rear enable their garrisons to make surprise counter-attacks, whereas some of the big permanent fortifications such as Fort Eben Emaël turned out to be veritable death-traps.

What we have written here we owe to Camille Rougeron, whose reasoned rehabilitation of field fortifications in face of the serious menace of tactical air power constitutes one of the many valuable contributions his book makes to the various aspects of the Korean conflict. The argument that air support for ground forces in an offensive has lost some of the effectiveness which the battles of spring 1940 and summer 1944 had shown it to have deserves serious consideration. The methods used by the Communists in Korea cannot always be applied, because of the nature of the subsoil. In northern Europe, for example, there is every chance of coming upon sheets of water before getting deep enough to disappear from view on the surface, as the Chinese and North Koreans are doing. In the Black Forest, the Vosges and the Alps it will be sandstone, limestone or granite that will meet the infantryman's pick and shovel.

On the other hand, if a major conflict should break out between East and West, all the diplomatic limitations which have hampered the natural development of the Korean fighting—which merely is an "episode in the Cold War"—would automatically disappear. As mentioned above, on a single morning, July 24th, 1944, to the west of Saint-Lô, it took 3,000 Allied fighters, fighter-bombers, twin and four-engined bombers, to make a breach of 7,000 yards in the line held by the German 84th Army Corps (von Choltitz) ; after the explosion of 3,431 tons of bombs the famous *Panzerlehrdivision* had tactically ceased to exist. What would be the results obtained today in a similar position by a single squadron of *Thunderjets* armed with tactical atom bombs ? Arithmetic suggests that the effect obtained would be almost three times as great and in particular that the casualties sustained by the personnel subjected to this bombardment would be out of all proportion to the relatively small losses reported by the *Wehrmacht* on the day that decided the battle of Normandy.[5]

Nevertheless conditions on the battlefield cannot always be forecast by reason alone. It may be assumed that the object of the recent Yucca Flat experiments has been to compare theory with practice in this field. We are told that some of the results have been somewhat disconcerting, and that the American infantry told off to exploit the effect of the atomic bombing were astonished to find animals still alive in the shelters. Let us not delude ourselves, however ; it would be dangerous to conclude that what applied to a goat would also hold good for a human being, especially a combatant, as these experiments do not enable us to check the psychological value of the weapon. It must also be remembered that the Nevada proving ground is a desert offering no hold for fires. If the dangerous effects of the tactical atom bomb should prevent the defenders from retrenching themselves in built-up areas or hiding from view in woods and forests, their task in Western Europe would become singularly uncomfortable. Stalingrad, Cassino and Caen would have succumbed in less than twenty-four hours, and the Reichswald near Nijmegen would not have held up the Canadian 1st Army for much longer on February 9th, 1945 . . .

Notwithstanding these uncertainties, one thing stands out clearly : on the defensive, tactical air power has not yet lost any of the qualities attributed to it in 1945. It was tactical air power that checked the North Koreans' first lightning offensive at the approaches to the Naktong redoubt, when the 2nd Infantry Division, hastily assembled in the United States, suddenly found itself responsible for a 45-mile front (August 1950). It was tactical air power which enabled the 10th Army Corps' 105,000 men, 17,500 vehicles and 350,000 tons of equipment and supplies to be re-embarked at Hungnam, on the east coast of Korea (December 1950) ; which brought the great Chinese onrush of November 25th, 1950, to a standstill south of Seoul ; which broke the two big Sino-Korean attacks of April 23rd and May 15th, 1951, transforming them into dreadful blood baths. Once air support formations, working in close cooperation with ground units, specially trained for such tasks, reached and maintained a daily average of a thousand sorties,[6] the Communists' poor strategy never stood a chance. In spite of the unequal number of the ground troops confronting each other in Korea, in spite of the political restrictions which prevented General Van Fleet from exploiting his 1951 victory, Kim Ir Sen's and Mao Tse-tung's venture has led to the indisputable defeat of the forces of aggression.

This is the moment to return to General Gruenther's remark that the campaign in Korea has seen the triumph of the infantry. Surely, nobody will doubt that during the first phases of operations, the Americans lacked seasoned, battle-hardened infantry, and this is what SHAPE's Chief of Staff had in mind when he made his statement. He will be considered right, and we should never think of reviving a famous saying of World War I, on the basis of experiences in Korea, that "the air force attacks, the infantry occupies." However, we should not lose sight of the fact that under the creeping barrage of fire put down by the U.S. 5th Air Force, the hapless North Korean and Chinese

[5] The *Panzerlehrdivision* had relatively slight casualties, but most of its equipment was rendered unserviceable. Hence its defeat, which led to the collapse of the Normandy front.

[6] The average figure was 104 during the period June 26th to July 10th, 1950. This is much lower than the figure for French Air Force sorties during the decisive days in 1940, when the troops fighting at Sedan and Dinant complained that they did not see a single aircraft in the sky ; cf. on this subject, General d'Astrier de la Vigerie : *Le Ciel n'était pas vide* ; Julliard, Paris, 1952.

When two napalm containers have been dropped, nothing remains of a North Korean supply train but smoking ruins.

A Boeing B-29 *Superfortress* dropping *fragmentation bombs* on North Korean attack columns.

infantrymen not even had the choice of their slaughterhouse. It has been said that, in order to escape the menace from the air, Mao Tse-tung's masses refuse to encumber themselves with any heavy equipment and launch their attacks without the support of tanks and artillery. The result is obvious : the first spring offensive broke down after four or five days, despite the sacrifice of 37,000 men ; as for the second, the Americans have good reason to nickname it the "May Massacre," since 65,000 men were sacrificed, whilst the American 8th Army recorded no more than 1,618 killed and wounded in six days and nights of attack and counter-attack. The air force had thrown in its full weight here.

At the time of writing we find more than 1,600,000 Chinese and North Koreans eliminated from the field of battle, including 132,000 prisoners, compared with 131,000 American casualties, including 33,500 killed or missing. Of the 97,500 wounded, 98 % have already recovered and 85% are again available for active service, whereas the majority of the enemy's wounded have perished miserably, for lack of medical care.

A *bridge* (foreground left) *being bombed* to hold up a North Korean advance. The Grumman F9F *Panther* shown from the aircraft carrier *Bon Homme Richard*, belongs to Task Force 77 whose mission is the blocking of enemy supplies to the front line.

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What then is the lesson to be learned for the eventuality of a full-scale East-West conflagration ?

By all the evidence, the tactical air forces, including the U.S. naval air units, would seem to be the only means at SHAPE's disposal, thanks to their striking power, flexibility and incomparable mobility, capable of compensating right from the outset the irremediable numerical inferiority of the West's ground forces. These tactical forces, well coordinated and acting in concentration for the common benefit, constitute SHAPE's only chance of slowing down and finally halting an invasion which, if it came, would put into the field forces two or three times as powerful as those of the Atlantic coalition.

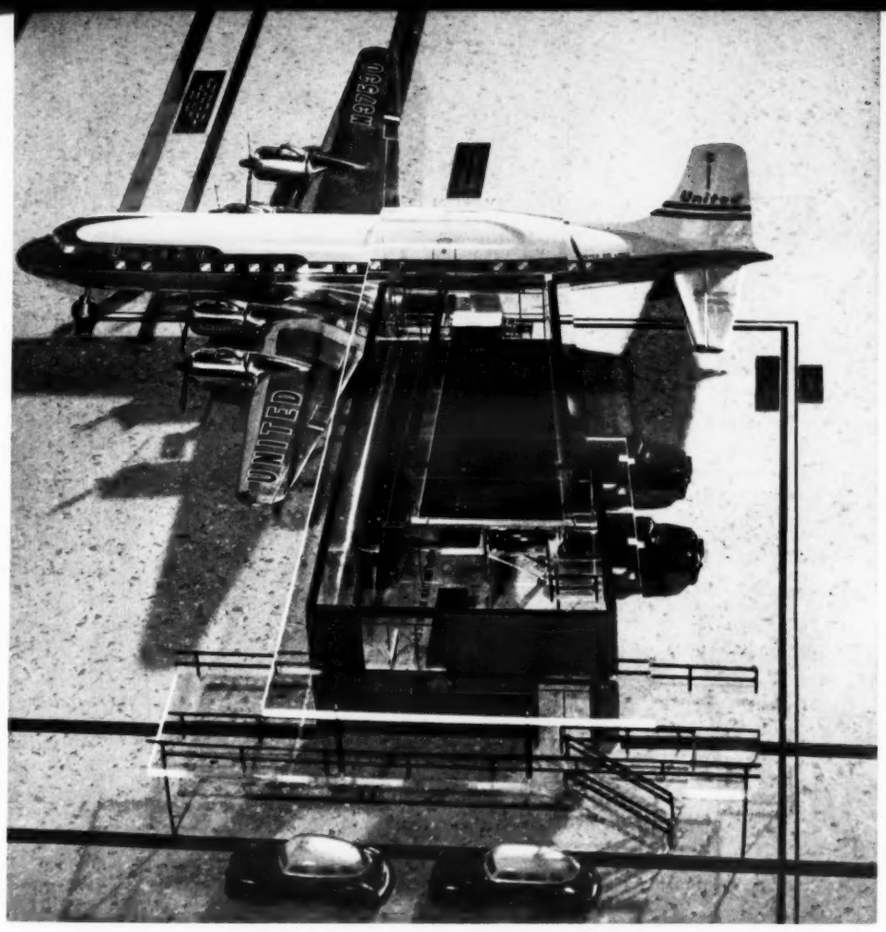
Here, too, field fortifications will afford NATO units protection against enemy air attack. What has been successful in Korea cannot fail to be equally effective in Europe—or even more so, since the West's sappers and engineering units possess mechanized equipment which will double or even treble the performance of the simple individual tool used in the Far East. This of course would not apply if the aggressor had tactical atomic weapons.

On the other side of the Iron Curtain, the invader's position would be much less advantageous, since he would be obliged to leave the protection of his fortifications in order to launch his attack. In this case he has two solutions to choose from : either he can organize his offensive in weight and unleash his heavy armoured columns, with support from his artillery divisions, following the methods which brought him success before Stalingrad and Berlin[7]; or else he will try to swamp his adversary's defences under a flood of light infantry, in the manner of the Chinese and Koreans on November 25th, 1950. The first method, with its inevitable concentrations and vast supply organization, would offer particularly rewarding targets to atomic or other bombs, rockets and napalm containers. The second would not find General Ridgway totally unprovided ; apart from the fact that such tactics failed in Korea, we should not forget that he now has eight armoured divisions out of the seventeen major units between the Rhine and the Iron Curtain.

Would the aggressors, submerged in napalm and riddled with rockets, follow the example of the Chinese after the "May Massacre," grab their shovels and disappear underground ? Possibly—even probably ; but it is an old truth that troops that dig do not attack. Thus in present day conditions, a stabilization in the ground fighting would give the weapons of large-scale destruction, of which only the Americans hold adequate stocks, time to obtain their strategic effects. It is no use imagining that a single atomic explosion would cause the defeat and dissolution of Communist Eurasia. The West would need much endurance before this result could be obtained. There is no doubt that air-ground and air-naval cooperation would enable them to reach their goal. But it means that the NATO forces must make sure of their air supremacy over Europe, as the Americans gained control of the air space over Korea, a week after the opening of hostilities.

This will not be altogether easy, in the face of the Red Air Force's thousands of jet fighters. But that is another question . . .

[7] The lining up of an artillery division implies uncontested control of the air space. In 1944 and 1945 the Luftwaffe's collapse enabled the Red army to set up whole forests of artillery without any camouflage, as shown in newsreels of the time.



One of UAL's *Mainliners* (a Douglas DC-6B) being moved up sideways to the *Airdock* on *Loadair* tracks. Passengers walk out straight on to the upper floor (waiting room in foreground, washrooms and offices nearby); baggage is brought in on conveyors to the ground floor, where buses and taxis await passengers under cover.

United Air Lines' Airdock Project

J. D. Crichton, airport engineer at United Air Lines' Denver, Colorado operating base, had an idea: "Why," he said to himself, "do our passengers have to tramp from the terminal building to the aircraft in all kinds of weather and then climb a flight of steps? Why couldn't the aircraft be brought up sideways to the waiting room, if for example their wheels were put on special trolleys and rails?"

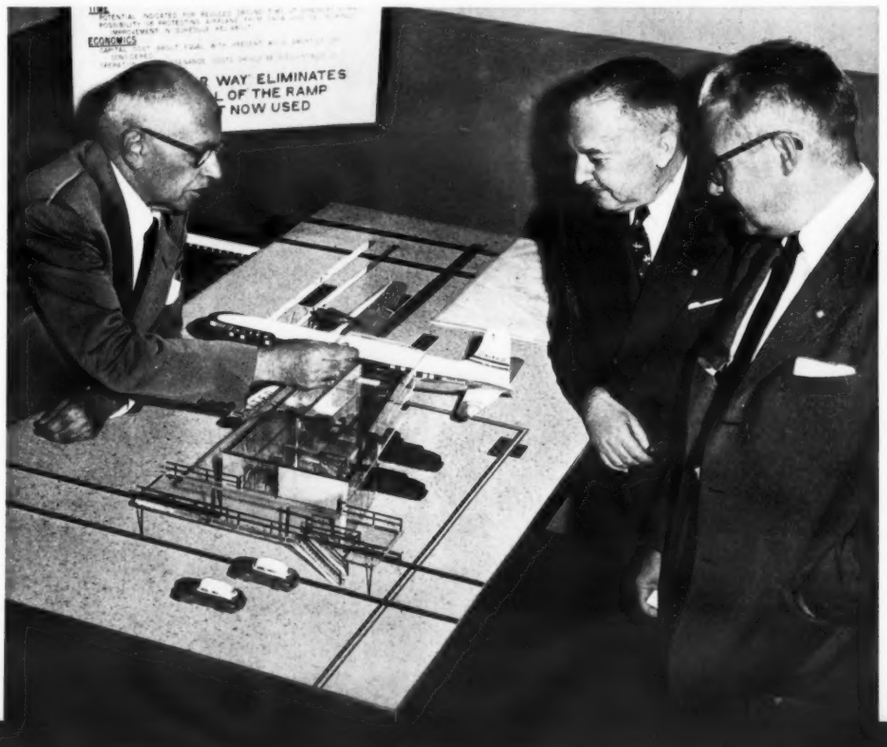
A first project was made. United's education and training department at San Francisco worked out a model, and Crichton showed his invention to W. A. Patterson, UAL President, and D. F. Magarrell, Vice-President, Transportation Services. They were enthusiastic. Magarrell believes that the new *Airdock* will revolutionize present day passenger and baggage handling methods. A number of Airdocks linked by a long (or arc-shaped) central building would give airports an entirely new appearance.

The proposed structure would be equipped with Whiting *Loadair* tracks, conveyor belts and other mechanical loading devices. An incoming aircraft would be taxied onto *Loadair* tracks and towed sideways up to the Airdock. Passengers would then step out straight into the upper floor without being exposed to wind or rain. While they walk down to the ground floor their baggage is being brought in by conveyor belt, the same belts also being used to unload airmail bags, express goods and cargo.

As the aircraft can then be refuelled, cleaned, equipped and loaded without the use of ground vehicles, it can be made ready for flight again in a much shorter time than with present methods. Chief advantages of the Airdock are: that it (1) protects passengers from inclement weather; (2) reduces time required to deliver baggage to passengers; (3) gives better working conditions for ramp employees; (4) reduces number of ground vehicles required; (5) substantially reduces aircraft ground time at stations; (6) and increases manpower efficiency in servicing aircraft.

Loadair equipment would have a single track for the main landing wheels, but separate nose wheel tracks to fit all UAL's aircraft, Convairs, DC-4s, DC-6s, DC-6Bs and (shortly) DC-7s. Two conveyors from the parking area would run through the cargo handling section to the baggage counter. The parking ramp would have radiant heating to keep it free from ice and snow, and water pipes and drains for cleaning the aircraft. Two service stands, flush with the ramp surface when not in use, would be raised hydraulically to working height when required...

"We are still in the planning stage," said Magarrell, "but already it is evident that the airdock would simplify and accelerate many ramp activities..." UAL is now working out plans for experimental installation at an airport.



J. D. Crichton (left), United Air Lines' President W. A. Patterson (centre) and D. F. Magarrell (Vice President, Transportation Services) examining a model of the *Airdock*.

Business as Usual at ICAO

Seventh Session of the ICAO Assembly at Brighton (England), June-July 1953

The title is in no way intended to suggest that the International Civil Aviation Organization is "resting on its laurels." On the contrary, delegates to this year's Assembly, to open at Brighton, England, on June 16th, will find themselves with a heavy schedule—perhaps the heaviest since the creation of the Organization at the Chicago Conference in 1944. The words "business as usual" refer primarily to the stories scuttlebutt has recently spread to the effect that Edward P. Warner, President of the ICAO Council, was preparing to resign, and that ICAO headquarters might soon move out of Montreal to some city in Europe.

However, according to latest reports, President Warner's energy is in no way abating, and there is no reason for him to retire from his responsible post. And ICAO's headquarters Staff does not seem to be at all dissatisfied with its quarters in Montreal's Aviation Building, into which it moved a bare two years ago. In any case rumours about a transfer to Europe have not only remained unconfirmed, but were even categorically denied a few weeks ago. Not least because of the willingness with which the Province of Quebec has agreed to considerable tax reductions and other concessions for the aviation organization and its personnel. *Interavia's* correspondent in Montreal also reports that Maurice Duplessis, Prime Minister of Quebec, is considering exempting ICAO from the five percent Canadian sales tax and granting an annual subsidy of $200,000 towards its rent in the Aviation Building. The Montreal authorities have already agreed to a substantial reduction in water rates. Finally more than thirty senior officials on ICAO's headquarters staff have been given diplomatic privileges by the Canadian Government. Externally then ICAO seems to be remaining unchanged. What of its activity ?

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To a certain extent the statements applying to ICAO's presidency and headquarters are similarly applicable to the working programme. If the provisional agenda published early in February 1953 is adhered to, the Seventh Assembly will probably continue on the same lines as its predecessors. The following are the most important questions which the various committees are expected to deal with during the projected four weeks of the Assembly :

Extract from the agenda for the 7th ICAO Assembly Session

Executive committee :

1. Character and scope of future Assembly sessions.
2. Contributions by member-States (punctual payment of dues; arrangements for settling contributions in arrears; action against members who fail to pay dues).
3. Relations with States and other International Organizations, including applications for membership in ICAO.
4. Technical assistance for economic development.
5. Policy in respect of amendments to or revision of Convention.
6. Revised Constitution of the Legal Committee.

Technical Committee :

1. ICAO programme in the technical field, including development and implementation of International Standards, Recommended Practices and Procedures; air navigation conferences and divisional meetings and the use, where needed, of standing committees and panels of experts to expedite work; annexes to the Convention, their amendment and relationship to procedures for air navigation services; application of Standards, Recommended Practices and Procedures.
2. Plans for the provision of air navigation facilities and services, including development and maintenance of regional plans and scheduling of regional meetings; implementation of regional plans; isolation and elimination of serious deficiencies in the provision of air navigation facilities and services.

Economic Committee :

1. General review of future programme and of working methods in economic field.
2. Prospects of and methods for further international agreement on commercial rights in international air transport: *a)* scheduled international air services; *b)* non-scheduled air transport operations.
3. Charges for airports and air navigation facilities.

Administrative Committee :

1. Budget for 1954.
2. Review of expenditures and approval of accounts—1952.
3. Payments by States in first quarter of financial year.
4. Apportionment of expenses among Contracting States, including assessment of States having adhered to the Convention since the Sixth Session; study of contribution principle; report on evaluation of "Interest and importance in civil aviation"; assessments for 1954.

Admittedly this programme sounds a bit dry. Yet the material interests at stake promise the most lively discussions even on those subjects which at first glance appear to be mere formalities. Point 4 on the Administrative Committee's programme, for example, includes a "study of the contribution principle." Here it should not be forgotten that membership of ICAO is a considerable financial burden for certain countries. For example, the Government of Uruguay has been trying for some time to get Parliament to agree to provide the necessary funds—unsuccessfully, which is not surprising in view of the country's dollar position. But even the United States recently complained of the high contributions demanded of it, which are difficult to reconcile with the general economies being made by the new Administration.

Nevertheless the question of contributions is only of secondary importance. The most vital problems today were dealt with by Dr. Warner in an article entitled "ICAO after Six Years" which appeared in IATA Bulletin No. 15 in mid-1952. The choice of this publication—so to speak the "house magazine" of the private enterprise International Air Transport Association—is interesting. ICAO has thus announced that it does not intend to deal with air transport problems purely round the conference table. On the contrary it is doing its utmost to keep in close touch with the airlines, so as to learn at the source what are air transport's everyday needs and desires, and to be able to unite with the airlines in finding a solution to the problems arising.

What are these problems ? Dr. Warner lists them in the order of their importance, as follows : regional planning in air navigation ; remedies for deficiencies in the air navigation services ; technical assistance for areas that are backward in air transport facilities ; facilitation of air transport through the reduction of customs and passport formalities ; status of scheduled and non-scheduled airlines ; multilateral agreement on commercial rights (Third, Fourth & Fifth Freedoms).

As regards the *technical questions,* the ICAO Council will not come before the Assembly with empty hands. Out of 50 typical *deficiencies* in air navigation facilities reported in 1951 (inadequate runways, deficiencies in meteorological or radio services, etc.), four fifths had been remedied within a year. *The technical assistance* programme for backward areas has succeeded beyond expectations, thanks to the willingness of more developed countries to provide aeronautical advisers and organize training courses. E. R. Marlin, new Director of Technical Assistance, can report substantial progress in the seventeen countries under his care (Abyssinia, Afghanistan, Burma, China, Formosa, El Salvador, Iceland, Indonesia, Iran, Iraq, Israel, Jordan, Lebanon, Pakistan, Syria, Thailand, Yugoslavia).

Satisfactory work has also been done in the *economic and legal field,* in particular on the problem of "scheduled and non-scheduled transport" (a definition of the two categories of transport accepted by the ICAO Council promises a considerable facilitation in practical regulation).—On the other hand it seems doubtful whether the revised draft of the *Rome Convention* (Liability of the aircraft operator in relation to third parties on the surface) accepted in Rome in November 1952 will get a sufficient number of ratifications.—As for the *multilateral agreement on air transport freedoms* which has been under discussion for years, it might perhaps be more tactful to pass over what has so far been achieved.

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Two new States, which have applied for membership of ICAO, will be sending delegates to Brighton to take part as observers ; they are Japan, to be ICAO's 58th member, and Libya, its 59th member. German observers are also expected to be present.

The Organization is filling up. Will it also include the Slav countries one day ? The answer to this question depends on whether the diplomats succeed in raising the Iron Curtain and opening the way to air services right round the globe.

What's in the Air? *

AVIATION POLITICS

NATO expenditure on air bases

● At the Paris meeting of the North Atlantic Treaty Council the 14 members of NATO agreed to share the costs of the new three-year plan for air bases (estimated as $887,000,000) as follows : USA 42.86%, France 13.75%, Great Britain 11.45%, Canada 7.13%, Italy 6%, Belgium 5.09%. The remaining 13.72% will be divided among the other NATO countries : Denmark, Greece, Holland, Iceland, Luxembourg, Norway, Portugal and Turkey.

French flight personnel charter

● The law introducing a charter for the flight personnel in civil aviation, signed by the President of the French Republic on April 4th, has now been published in the Journal Officiel. In addition to rules for collective contracts between air transport undertakings and air transport personnel, it contains general definitions of the various categories of flight personnel (aircraft captain, engineer, non-navigating flight personnel, etc.) and rules for the issue of certificates and licences. Fines and terms of imprisonment are provided for persons exercising the duties of flight personnel without the requisite qualifications, or those permitting such duties to be performed by non-authorized personnel.

Czechoslovak defence budget for 1953

● According to Radio Prague, only Kr. 41,800,000,000 out of the total Czech budget of Kr. 430,900,000,000, or a mere 9.7%, is earmarked for defence in 1953. The Minister of Finance is said to have given particular stress to this point in his budget speech and compared the Czech figures with American defence expenditure. However, NATO quarters point out that Eastern *bloc* countries are known to include defence expenditure under other budget headings (Ministry of the Interior, Industry, Transport, etc.), and that the individual credits are not described in detail. Leading NATO staff officers are reported to have stated at the Paris conference that armament in Eastern European countries had been decisively modernized during the past year (heavy tanks, jet aircraft, etc.). A striking feature was the improvement in tactics in the Czech forces, whose officer corps had been radically rejuvenated during the past eighteen months. The great majority of the officers in service today had taken at least a year's special course in Russian training centres.

SERVICE AVIATION

Underground jet fuel pipeline

● British Defence Minister Lord Alexander has stated that a beginning has already been made on the construction of a network of underground pipelines for jet fuel to connect up European NATO bases. NATO experts have been stressing for some time that the transport of large quantities of jet fuel on normal routes during wartime would be extremely difficult.

Edwards Air Force Base

● Levelling work for the "world's longest runway" has begun at Edwards Air Force Base, in the Mojave Desert, California. Laying of the concrete for a basic strip 15,000 ft. long and 300 ft. wide is to begin in October. This will take aircraft up to 500,000 lbs. in weight. Beyond the concrete strip the desert, including several dry lakes, is to be levelled to provide a landing strip 22 miles in length.

U.S. mission for Woomera

● A party of ten guided missiles experts, headed by Dr. Clifford Furnas, Chairman of the Guided Missiles Committee of the U.S. Research and Development Board, has gone to Australia, where they will spend several weeks at Woomera rocket range. Representatives of the three fighting services are understood to be included in the party.

Russian air bases in Europe

● General Alfred M. Gruenther, SHAPE Chief of Staff, recently told the Senate Foreign Relations Committee that the Soviet Union had over 300 air bases in European territory, from which a "very effective" attack could be made on the West. The Atlantic Powers on the other hand had only 40 "effective" bases, and it would be 18 months before a balance could be struck.

AIR TRANSPORTATION

World scheduled traffic in 1952

● The world's scheduled airlines flew a total of 1,037,900,000 miles in 1952 (this corresponds to 209 return flights to the moon).

Norbert R. Bensabat has been appointed Manager of the French office of Pan American World Airways. Bensabat has been with PAA for more than 12 years.

IATA Helicopter Symposium

● A three-day helicopter symposium was held during the International Air Transport Association's Sixth Technical Conference at Puerto Rico, which was attended by delegates from 69 airlines and by representatives of national authorities, manufacturers and research institutes. The guests included : Igor Sikorsky of United Aircraft ; Frank Piasecki of Piasecki Helicopter Corp. ; Pierre Bréguet of Ateliers d'Aviation Louis Bréguet, etc. Chairman of the talks, J. T. Dyment, Trans-Canada Air Lines' Director of Engineering, made the following forecast : "By 1958 or 1960, manufacturers will be able to produce, and airlines will have had sufficient experimental experience to operate 30-passenger helicopters on regular schedules inside metropolitan areas, between cities up to 150 to 200 miles apart, and between islands and country areas in the same general range. These helicopters will have at least two piston or turbine engines and will be able to cruise at about 150 miles per hour. Passengers will carry their own baggage, and the interior of the helicopters will give a modern, bus-type standard of comfort. On inter-city routes, helicopter bus tickets will probably cost about as much as an airline ticket between the same two points, plus the price of the city-to-airport limousine. In metropolitan service, fares may run in the same range as taxicabs."

Trans-Canada Air Lines = Air Canada

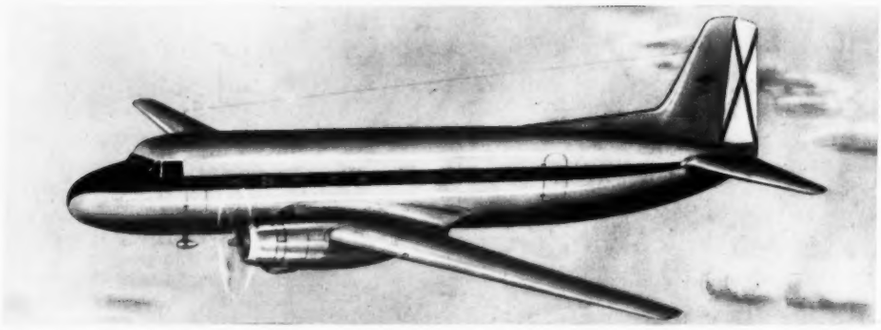
● The Canadian Government has empowered Trans-Canada Air Lines to use the second name "Air Canada." The company, which has been using this name in its French advertising for some time past, argues that "Air Canada" sounds more international, as it recalls "Air France," "Air India," etc. "Trans-Canada Air Lines" on the other hand has a "local flavour."

Facilitation conference in Cannes

● The French Government organized an international conference on the facilitation of air transport in Cannes on May 26th, to which the following countries and organizations were invited : Belgium, Denmark, Allied High Commissioners for Germany, Finland, Holland, Greece, Great Britain, Ireland, Iceland, Luxembourg,

* Extracts from "Interavia Air Letter," daily international news digest, in English, French and German. All rights reserved.

A three-day *Helicopter Symposium* was the central feature of *IATA's Sixth Technical Conference in Puerto Rico*. Delegates from 69 airlines and representatives of national authorities, manufacturers and research institutes throughout the world discussed the future of the helicopter in scheduled service. Left to right : G. B. Clark, Asst. Vice President, Bell Aircraft ; N. R. Hafner, Chief Designer, Helicopters, Bristol ; Igor Sikorsky, Sikorsky Division, United Aircraft ; Bernard L. Whelan, General Manager, Sikorsky Aircraft ; John Drummond, Vice President, Canadian Pratt & Whitney Aircraft ; Grahame H. Aldrich, Special Projects Director, Air Transport Association.



Static load tests on the first of two prototypes of the *CASA 207* twin-engined airliner, built by Construcciones Aeronauticas S.A., Madrid, have begun.

Norway, Yugoslavia, Austria, Portugal, Sweden, Switzerland, Spain, Turkey.—ICAO, IATA, FITAP, FAI, International Chamber of Commerce.

Report on Swiss commercial aviation

● The "Report on the Organization of Swiss Air Transportation and Swiss Air Transport Policy" submitted to the Swiss Parliament advises against Switzerland's giving up its own air services or limiting them to short or medium stages. During the 1952/53 winter season Switzerland had been served by 27 Swissair services and 41 services operated by non-Swiss airlines. If Swissair withdrew it would leave a sensible gap, and Switzerland would depend for air services on decisions made by foreign countries. It had also been found that Swissair was quite able to compete with other airlines on the profitable Atlantic services.

INDUSTRY

"Peace offensive" and aircraft industry

● In the view of certain financial circles, the success of the present peace talks in Korea would confront the American aircraft industry—as a specifically armament industry—with serious problems, as sharp cuts in orders would have to be expected, similar to those after the end of World War II.—However, leading industrialists seem to be more optimistic. For example, Harlow H. Curtice, recently elected President of General Motors Corp., told guests at a business luncheon that there would be little if any cut-back of aviation orders this year in the event of peace ; large blocks of Governmental appropriations for 1953 had not yet been consumed by industry ; and U.S. military aeroplanes, jet engines and missiles "are yet to be produced in any real quantity."

Douglas nearly quit building aircraft . . .

● Donald W. Douglas told stockholders that the company has completed the design for the DC-8 jet transport, but declined to state when construction would begin. "I am convinced that we are going to build a jet turbine airliner," he said, "but when that will be is another matter." Few Douglas stockholders realized from these words—INTERAVIA's West Coast correspondent reports—that Douglas was solving a major question concerning his company's future. Up to the moment of the meeting there was a strong possibility that the company might abdicate its position as one of the biggest aircraft manufacturers and convert to the production of guided missiles. For several weeks Douglas is believed to have isolated himself from his advisers, to avoid influence in making what is probably the most critical decision of his career.

Argentina's IAME during second Five-Year Plan

● The sum of 515,000,000 pesos has been provided for under Argentina's second Five-Year Plan for expansion of Industrias Aeronauticas y Mecanicas del Estado, the country's Government-owned aircraft and automobile company. Of this sum, 100,000,000 pesos is for the 1953/54 year.

Revival of the German aircraft industry

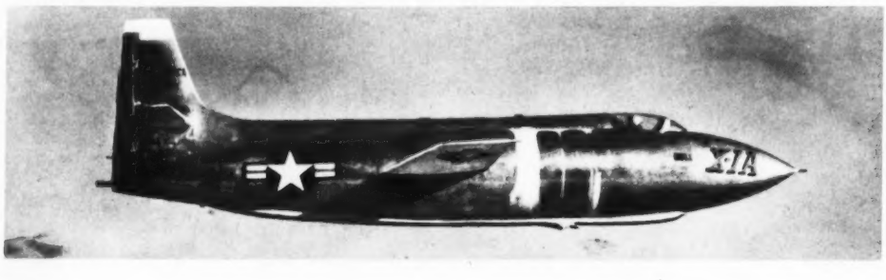
● At a recent press conference in Düsseldorf Professor Leo Brandt, member of the Board of the AG für Luftverkehrsbedarf, advocated the rapid revival of the German aircraft industry. The grant of foreign production licences would probably not present a problem, since offers had already been received, and the possibility was being weighed of making the purchase of foreign aircraft for the Lufthansa conditional upon willingness to cede licences. Professor Brandt considers that German manufacturers will be quite ready to build aircraft. Messerschmitt, Heinkel, Dornier, Focke-Wulf had production plant covering an estimated area of 3,230,000 sq.ft., and had been able to keep together a nucleus of skilled workers.

AIRCRAFT

● The *Bell X-2* research aircraft, now undergoing flight testing, is later to be fitted with a rocket engine of approx. 20,000 lbs. thrust. It is expected to reach altitudes of between 100,000 and 200,000 ft. ; take-off weight approx. 29,000 lbs., weight empty between 16,000 and 18,000 lbs.

● *Douglas C-132* is the designation of a new turboprop version of the Douglas *Globemaster*. The C-132—not to be confused with the YC-124 B experimental model also fitted with turboprops—is to have four turboprops derived from the Pratt & Whitney J-57 turbojet.

The *Bell X-1A* supersonic rocket aircraft has made its first flights at Edwards Air Force Base, California.



● *Chance Vought* announces a carrier-based low-level attack version, designated *A2U*, of the F7U *Cutlass* carrier fighter. The U.S. Navy plans to place an order for a substantial number of A2Us.

● According to unconfirmed reports, the *Convair XF-102* delta-wing fighter is to be ready for flight testing by October 1953.

● The *Convair XF2Y-1 Sea Dart* delta-wing fighter seaplane with hydro-skis has now begun flight testing.

● Three new versions of the *Bristol Britannia* propeller turbine airliner are announced : the *Britannia 200* for cargo operations, *Britannia 250* for mixed passenger and cargo services, and the *Britannia 300* for passenger traffic.

Hispano HA-200 C-1, a two-seat trainer with 450/500 h.p. engine projected by Hispano Aviacion S. A. (works at Guadalajara and Seville). Other two-seater designs of this firm : Hispano HA-100 E-1 with 750 h.p. engine ; a jet design with two Turboméca *Marborés*.

● *Vickers-Armstrongs* has produced a project for a *Viscount 750* version of the four-engined airliner. With the same dimensions as the original 700 or 701 versions, the 750 can carry a greater fuel load (increased range).

RADIO EQUIPMENT

● The German electronics industry has begun to be active again in the field of radionavigation. On the one hand it is producing equipment and installations under licence from the United States and Great Britain, and on the other it is bringing earlier designs of its own up to date.

Telefunken is making radionavigation equipment of its own design and under foreign licence. Its own designs are : radio beacon transmitters (medium wave) for shipping and air navigation, and relevant ground D/F equipment ; short wave ground D/F installations (Adoock equipment) and VHF ground D/F for aircraft location. *Bendix* licences are being used for GCA radar equipment, for airport surveillance (type ASR-3) and for instrument landings (type PAR-2). *Decca* licences permit the production of Decca Navigator transmitter and receiver installations.

Lorenz is building improved ILS approach beacons with glide path and *Consol* transmitters of its own design, also VOR beacons under American licence.

Siemens has apparently not yet found its place in the production of radionavigation equipment, but is working on promising developments in the VHF field.

Pintsch-Elektro is supplying VOR air-borne receivers under licence from National Aeronautical Corp., and ILS receivers. The firm's own designs include measuring instruments for centimetre and decimetre systems.

The *Atlas Werke* are at present making only ships' radar under Raytheon licence.

C. Plath has brought out its well-known visual D/F equipment again ; *Rohde & Schwarz* is supplying an air traffic control receiver for the 100-156 mc/s frequency band ; *Funktechnische Werke* are working up American aviation radio equipment from scrap, and *Hochfrequenz-Gerätebau Hechingen* is assembling equipment from old German scrap parts.

The SNECMA Escopette Pulse-Jet

by J. BERTIN, in charge of Special Projects, F. Paris and J. Le Foll, Engineers, SNECMA, Paris

I. *Historical Survey*

The SNECMA *Escopette* pulse-jet, which has been fitted in two *Emouchet* gilders built by SEVIMIA (Société d'Etudes Victor Minié), is the first power plant without moving parts—excepting for obvious reasons rockets—which enables a piloted aircraft both to take off and to fly entirely independently.

The history of this engine goes back to the end of 1943. One of the authors, convinced of the value of constant volume combustion (the Lenoir cycle without pre-compression has a theoretical efficiency of 27%), had the idea—which he thought was a new one—of an engine with intermittent combustion and hence with partially constant volume of the

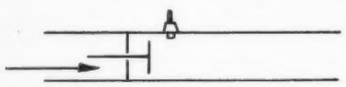


Fig. 1 : Entry valve, controlled by gas pressure, at the forward end of a pulse-jet pipe.

burning gases. His original design was roughly as shown in fig. 1, with a valve at the head of the pipe.

Today, of course, everybody recognizes a diagram of the principle of a pulse-jet with flap valves. But at the time the author knew nothing of this, although he had been working on aircraft power plants for a long time.

The idea was submitted to Chief Engineer R. Marchal, head of the Centre d'Etude des Moteurs à Huile Lourde (Test Centre for Heavy Oil Engines) *, who showed interest in it but raised certain objections to the use of valves.

He feared they would not be sufficiently tight and would create losses due to the inevitable dephasing of the movement of gases in relation to that of the valve. A new suggestion was made, that a spring be placed on the valve with a frequency equal to that of the movement of the gases.

It might thus be possible to reduce the dephasing to a minimum, as the energy taken up from the flow to move the valve is practically negligible.

* C.E.H.L. was an organization under the Technical and Industrial Directorate of the Air Ministry and was at Lyons at the time. Later, in 1947, it was incorporated in SNECMA. Its head, M. Marchal, had meanwhile become Technical Director of this company.

Although this provided a fairly effective solution to one at least of the problems, Mr. Marchal suggested that all moving parts should be eliminated and the valve replaced by a device which favours flow in one direction and hinders it in the opposite direction. This device was named a " detector " (an analogy with the well-known element in early radio sets. Ed.). He suggested the use of vortices as a means of differential throttling. Historical development was then as follows :

- July 10th, 1944, first " vortex detector " was designed,
- the end of 1944 and 1945 were spent in giving this detector satisfactory characteristics,
- May 1946 first correct pulse combustion was obtained, but with auxiliary blower to assist admission,
- 1946 to end of 1947, systematic development of new types of detector,
- April 15th, 1947, first running of a pulse-jet without flap valve yielding static thrust (Engineer Sarrazin),
- March 1950, design of *Escopette* in present form,
- December 19th, 1950, SNECMA's test pilot Gouel took off at Melun-Villaroche in the *Emouchet* glider fitted with four *Escopettes* (installation in collaboration with Engineer Jarlaud of SEVIMIA).[1]

As already mentioned, the author originally believed his idea to be a new one, but was not long in discovering that this was not the case. Technical literature and above all patent specifications showed him that a great many persons had already worked on the problem and that the idea of the pulse-jet, with or without flap valves, was clearly glimpsed by some of them as far back as 1908.

The discovery of a phenomenon on which the functioning of a pulse-jet is founded,

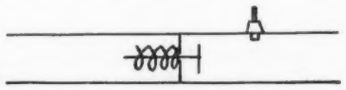


Fig. 2: Spring-loaded entry valve (with frequency adjustment) at the forward end of a pulse-jet pipe.

namely the negative pressure which follows the emptying of a pressurized container when suddenly opened (sometimes called " Kadenacy effect ") may even be said to go back to Huygens, who described a prime mover working on this principle with gun powder.

However, the first models of pulse combustion chambers did not appear until the 20th century. They used the negative pressure effect discovered by Huygens as an accessory to permit of successive fillings of a chamber to provide approximately constant volume combustion.

The important characteristic, it should be stressed, is this phenomenon of constant volume of the burning gases. In this sense pulse-jets are directly related to piston engines and differ from turbojets and ramjets, in which the gases are burned under more or less constant pressure.

There is another little-known category of reaction engine—piston engines with a jet pipe—in which only the exhaust energy and thermal losses are used for propulsion, the connecting rods being used only to fill the chamber and provide pre-compression. This system, put forward by Lorin in 1908, was seriously examined during the last war but then dropped.

The only way in which pulse-jets differ from the latter type of engine is in their automatic filling, which permits of great simplicity of design. This simplicity has attracted the interest of a great many researchers.

Holzwart, for example, began working on a combustion chamber with automatic valves to feed a gas turbine in 1908. Marconnet, in 1909, suggested models very similar to the *Escopette* ; in 1910 Caravodine made a gas turbine actuated by a combustion chamber without pre-compression, with an efficiency that would not be regarded as ridiculous even today. Esnault-Pelterie also made an important contribution to these studies.

Thus the basic principles of intermittent combustion and even the main special equipment, such as flap valve grids, had been worked out before 1914.

After 1914 all this seemed to be forgotten and no further traces of work in this field were found. It was not until 1930 that the

subject was taken up again in various countries, and only the work carried out in secret in Germany by Paul Schmidt produced a practical model, namely the Argus-Schmidt tube used in the V 1 flying bomb.

This engine was not known in France until the beginning of 1945. The work described in this article had begun before that date, and in any case the Argus-Schmidt tube had mechanical flap valves, whereas the SNECMA pulse-jet eliminated these from the beginning.

It is this new aspect of the question which is dealt with in greatest detail in the following paragraphs.

II. General remarks on functioning

As the general functioning of the *Escopette*, apart from the detector, does not differ to any marked extent from German pulse-jets, we shall do no more than quote a passage from a memorandum by Paul Schmidt which adequately describes its kinematics.

" The figure (Fig. 3) shows a diagram of the kinematics of a pulse-jet with its different operating phases.

" The pipe has an admission valve for the combustion air (left in the diagram, indicated by a double line). This permits the entry of a flow of fresh air enriched with petrol, but prevents the combustion gases from returning after ignition of the mixture, i.e., when there is positive pressure inside the pipe.

" The top diagram (a) shows conditions at the beginning of the cycle : there is a charge of fresh mixture near the admission valve. The rest of the pipe contains burnt gases from the previous combustion and even fresh air near the exit orifice.

" Diagram b shows the position immediately after ignition, with three small arrows indicating the effect of the pressure due to combustion.

" This pressure advances very rapidly, and the column of gases in the pipe is pushed towards the rear (diagrams c to f), a movement which continues even after the positive pressure has disappeared, so that air is drawn in through the admission valve. The negative pressure now in the pipe, particularly near the valve, draws the column of gases back into the pipe, as indicated by the rear arrows in diagrams g, h and a. Because of this return movement, air also enters the pipe through the exhaust orifice but will be expelled again during the next cycle.

" Thus the pipe works on a definite frequency. In addition to the automatic admission of fresh air, there is automatic ignition at a high combustion speed."

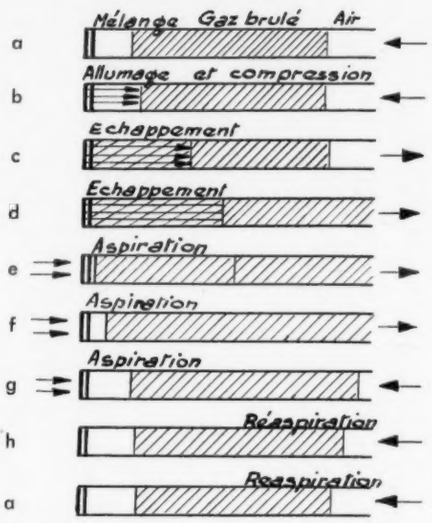


Fig. 3 : Kinematics of a pulse-jet according to Paul Schmidt, a—mixing of burnt gases with air ; b—ignition and compression ; c—exhaust (phase I) ; d—exhaust (phase II) ; e—suction (phase I) ; f—suction (phase II) ; g—suction (phase III) ; h—return suction (phase I) ; a—return suction (see above).

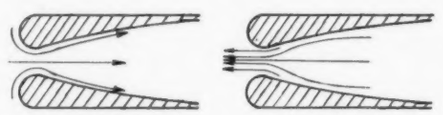


Fig. 4 : Venturi tube as simplest example of a " gaz flow detector ".

It will be seen that the column of gases in the pipe plays a double role in the combustion process :—

a) during combustion it resists the expansion of the burning gases, thus putting them under positive pressure, an essential condition for the production of motive power ;

b) after combustion it furnishes the work required for the admission of a new charge of air-fuel mixture.

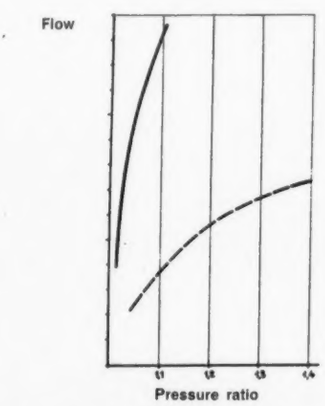


Fig. 5 : Flow through an entry detector during suction (unbroken line) and during expulsion (broken line) as a function of the pressure ratio.

III. *Detectors*

These essential functions can still be obtained if the flap valves are replaced by an orifice which is more permeable in the admission direction than in the return direction. The ratio of permeability (in the two directions), or " coefficient of detection ", must be sufficiently large. Such an orifice is known as a " detector ". Its simplest example is a venturi tube (fig. 4).

The Mach number at the neck, in both directions, depends solely on the ratio of the upstream pressure to the pressure at the neck (or downstream). The same Mach number can be obtained at the neck with a smaller ratio between upstream and downstream pressures in the admission direction than in the opposite direction.

The detectors were the objects of a large number of experiments which included the measurement of flow as a function of the ratio between upstream and downstream pressures in the two directions (fig. 5). During these experiments attempts were made to meet the following conditions :

— high flow in the admission direction
— high permeability ratio
— light weight and ease of construction
— smallest possible volume.

Two types in particular were examined : the vortex detector (fig. 6) and the funnel

Fig. 6 : " Vortex " detector : the arrow marks the direction of suction.

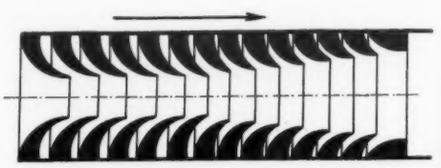


Fig. 7 : " Funnel " detector : the arrow marks the direction of suction.

detector (fig. 7). Both of these had high permeability ratios (5 and 4 respectively).

The latter model was found to be better than the former, in spite of its lower permeability ratio. This unexpected result can be explained by examining the dynamic aspects of " variable flow ".

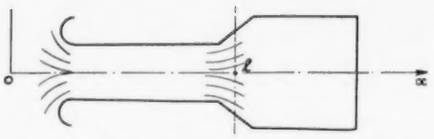


Fig. 8 : General arrangement for a variable flow : pressure (p) and velocity of flow (v) are functions of time (t) and position (x) ; allowance also has to be made for density ρ.

IV. *Variable flow*

Let us imagine a container connected to the atmosphere by a cylindrical pipe with a rounded lip, and assume (fig. 8) that :

— the fluid is incompressible in the pipe, but compressible in the container,

— the flow is unidimensional and adiabatic in the pipe, its lip to the atmosphere and transition part to the container,

— the container has previously been placed under negative pressure.

Let initial time t_1 be that at which atmospheric pressure is reached again in the container and let v_1 be the speed in the pipe at this moment.

Euler's equation is written :

$$\frac{\partial p}{\partial x} + \rho\left(v\,\frac{\partial v}{\partial x} + \frac{\partial v}{\partial t}\right) = 0$$

and the equation of continuity in the cylindrical pipe :

$$\rho\,\frac{\partial v}{\partial x} = 0$$

v and $\partial v/\partial t$ are functions of t, so that Euler's equation can be integrated as follows :

$$p\ (l,\ t) - p\ (0,t) + \rho l\,\frac{\partial v}{\partial t} = 0$$

As the atmospheric pressure can be regarded as applying to point of origin 0, or : $p\ (0,t) = 0$ this equation can be integrated between t_1 and t_2, thus giving the areas hatched in fig. 9 :

$$P\ (t_2) = \int_{t_1}^{t_2} p\ (l,\ t)\ dt$$

$$P\ (t_2) = \rho l\ (v_1 - v_2)$$

Numerical application :

$$\rho = 10^{-3}\ t \cdot m^{-3}\ ;\ l = 0.5\ \text{m}$$

$$v_1 = -\,v_2 = 200\ \text{m/sec}$$

$$P\ (t_2) = 10^{-3} \times 0.5 \times 400 = 0.2\ \text{pz} \cdot \text{sec}$$

For example, for $t_2 - t_1 = 2 \times 10^{-3}$ secs, mean positive pressure equals 100 pz, which corresponds to a maximum pressure of 120 to 150 pz for the habitual forms of pressure distribution versus time.

Once p, l, v_1 and v_2 are fixed, area $P\ (t_2)$ is determined. A combustion or for example a supply of fluid through a second orifice (not shown in fig. 8) act of course on the mean positive pressure.

The numerical values envisaged show that it is possible to maintain a marked positive

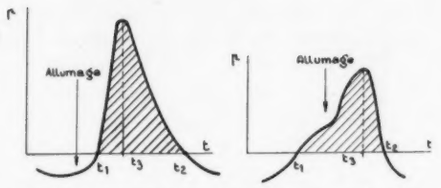


Fig. 9 : Pressure-time diagrams for early ignition (left) and late ignition (right).

pressure throughout combustion (2 to 3 milliseconds) by means of the processes which have just been described. The compressibility of the gases modifies this picture and makes it more complicated, particularly when the pipe occupies a large proportion of the total volume. However, it gives a fairly accurate idea even when the flow is transonic (cf. fig. 12).

*

V. *Application to the pulse-jet*

Paul Schmidt placed considerable emphasis on the fact that the negative pressure which fills the combustion chamber from the front also produces a return movement by the gases contained in the exhaust pipe, a movement which in turn hinders the rearward expansion of the gases during combustion, or even creates a slight pre-compression. Applied to the exhaust pipe, the preceding calculations illustrate Paul Schmidt's affirmation and make it easier to understand the thermodynamic principles of pulse-jets with flap valves.

Thus the movement of the column of gases resists expansion of the burning gases and creates a positive pressure whose mean value is inversely proportional to the duration of combustion. This shows the advantage of short-period combustion. In fig. 9 it will be seen that between t_1 and t_2, the specific volume of the gases in the container decreases at first up to a certain moment t_3, then increases.

The optimum moment for ignition depends on the relative increase in temperature caused by the combustion, the duration of the latter and the form of pressure distribution versus time, but it is always before t_3. If combustion is very slow or produces a substantial increase in temperature (complete filling and high richness), this moment may be earlier than t_1. In actual fact, filling is always very incomplete, which greatly reduces the relative increases in temperature and pressures produced by the combustion. These major disadvantages are balanced by a high speed of combustion. In general the ignition point is between t_1 and t_3, and fairly near to t_3.

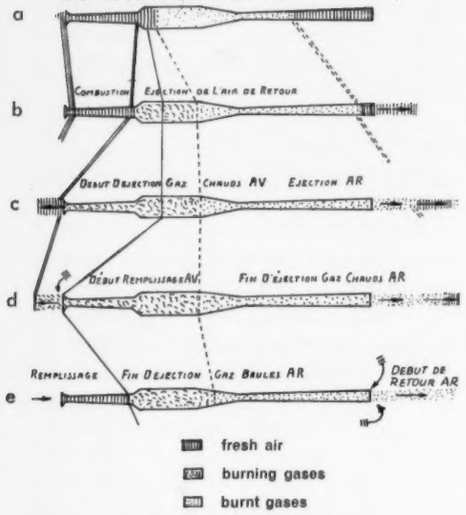
The real cycle is therefore more closely related to that of Beau de Rochas than that of Lenoir, but the dilution of the fuel mixture in the burnt gases limits the theoretical efficiency to a value very much lower than had been expected.

VI. *Application to the detector*

The above examination shows that once launched towards the chamber, a column of fresh air can " close " the latter during combustion. We can now turn to the admission, applying this phenomenon to the front of the pipe, combining it with the detection pure and simple described earlier. The only pulse-jets without flap valves which have ever functioned with performance comparable to that of Schmidt's tube used this last principle. More exactly, the favourable inertia effect shows itself spontaneously as soon as the column extends up the chamber over an appreciable length. This is what happened with the device known as the " funnel detector " and explains its superiority over the " vortex detector ". Later we made systematic use of the effect of inertia, sacrificing detection proper in the " smooth-tube detector " which is an extended venturi tube (see fig. 12).

In the preceding we have above all examined the effect of inertia which tends to compress the gases in the chamber ; but there is also an inertia effect in the other direction which tends to empty it. It is this effect, in the exhaust pipe, which enables the chamber to be swept out, the admission being made via the other orifice. In the detector, on the other hand, its effect is to increase escape forwards and to hamper filling. But this escape does not occur until after combustion, and thus has no direct detrimental effect on thermal efficiency. Moreover the burnt gases leaving the chamber cannot be ejected until they have pushed before them a large volume of air that has not been mixed with fuel. The movement stops in general at the beginning of their final ejection (fig. 10c and 10d).

The forward-moving burnt gases, which no longer contain oxygen, are again mixed with fuel as they pass the injector zone, but the fuel is not lost, since they are almost entirely reabsorbed during the next sequence (fig. 10e). The fuel is even completely vaporized, heated and thoroughly mixed, which assists rapid combustion. A rough atomization of the fuel, and hence a very moderate injection pressure, are therefore sufficient. On the other hand, there is a reduction in filling. Figs. 10, 11 and 12 show the different phases of operation. They were produced by Mr. Salmon on the basis of pressure and temperature measurements made at several points of the pulse-jet by means of recording



$t = t_a$ — *end of filling from front and rear.*
$t = t_b$ — *combustion and rearward expulsion of return suction air.*
$t = t_c$ — *beginning of exhaust of hot gases forward ; expulsion rearwards.*
$t = t_d$ — *beginning of filling from front ; end of expulsion of hot gases rearwards.*
$t = t_e$ — *filling ; beginning of return suction.*

Fig. 10 : Diagram of operation of a pulse-jet with smooth-pipe detector.

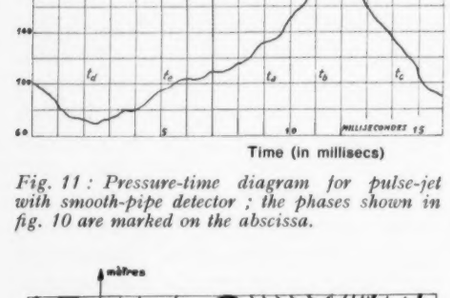


Fig. 11 : Pressure-time diagram for pulse-jet with smooth-pipe detector ; the phases shown in fig. 10 are marked on the abscissa.

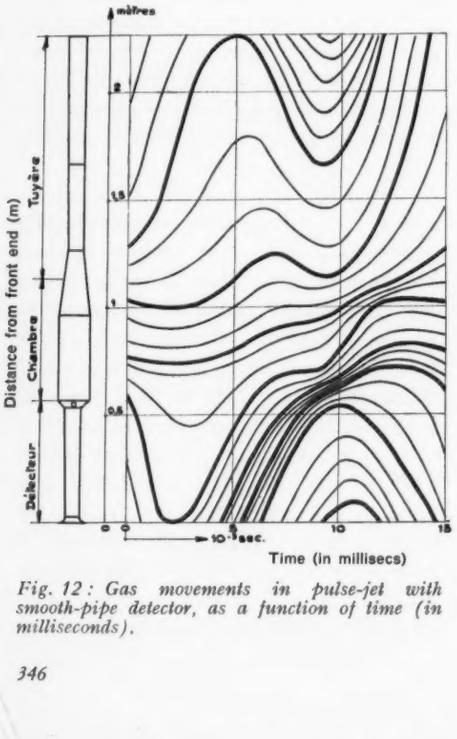


Fig. 12 : Gas movements in pulse-jet with smooth-pipe detector, as a function of time (in milliseconds).

instruments provided by SNECMA's measurements services under M. Fleury. The values of pressure (p) absolute temperature (T) and $\partial p/\partial x$ having thus been measured, it was possible to calculate speeds and determine trajectories by integrating Euler's equation :

$$\frac{\partial p}{\partial x} = \frac{-1}{R}\,\frac{p}{T}\,\frac{dv}{dt}$$

The ejection of air forwards at a high speed would result in a considerable loss in thrust. It is therefore necessary to use a device to turn the air jet backwards without disturbing the admission too much.

Making allowance for the small bulk of this device, it was possible to obtain specific thrusts (in relation to either weight or frontal area) superior to those of the V 1 power plant. Specific consumptions are also noticeably lower.

VII. *Life of pulse-jet without flap valves*

The short life of the V 1's power plant was due solely to the low endurance of the flap valves, so that if relatively cold detectors with no moving parts are used, the engine's life then becomes that of the hot part. The elimination of mechanical flaps also does away with shocks and their harmful effects.

By including a simple spring in the engine suspension it is possible to eliminate all vibrations that would otherwise be transmitted to the airframe. Simultaneously the alternating stresses inside the engine itself are reduced to the minimum compatible with the periodic nature of its operation.

The only major stresses that remain are those that result from the variations in internal pressure, as the pipe is alternately under positive and negative pressure. The pipe is circular in section.—Although the fatigue strength of stainless steel decreases rapidly with temperature, the endurance of the pipes was found to be definitely superior to what had at first been expected, despite temperatures of the order of 850° C.

The results of the experiments were encouraging (fig. 13), thanks to improvements in manufacture, particularly a careful choice of the position of the welding seams, the utmost attention to the welding itself and a strict inspection of the metal sheets used. Ruptures occur as a rule independently of the seams, after a certain time which varies according to the nature and thickness of the material used. For example, the sheets of stainless steel with low nickel content used in the *Escopette* were 4/10 to 6/10 mm thick depending on where they were used, and a reduction of 10 % in one of these thicknesses would reduce the endurance from about 50 hours to 5 hours.

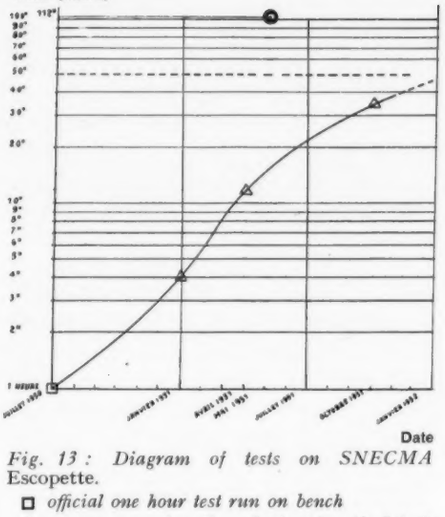


Fig. 13 : Diagram of tests on SNECMA Escopette.
□ *official one hour test run on bench*
△ *average running time during practical tests in the* Emouchet *glider*
○ *bench tests under simulated flying conditions (3 mins. idling plus 10 mins. max. thrust)*
--- *anticipated minimum endurance*

To sum up, the very short life of pulse-jets with flap valves could only be lengthened to several hours at the expense of the thrust, and the engine would be suitable only for use in an expendable machine (the V 1 for example). On the other hand the pipe of a pulse-jet without flap valves enables it to be used as a " consumable " engine or even a long-life engine, depending on the weight selected. Even now our pulse-jet, with a life of about fifty hours, has a thrust/weight ratio of about 6.

VIII. *Glider with auxiliary pulse-jets*

The basic thrust of the pulse-jet with a single detector is rather low, and the diameter of the pipe is small.

However, several pulse-jets of this type (four and six *Escopettes*) have been used experimentally as an auxiliary power plant in SEVIMIA *Emouchet* gliders, to provide practical experience. There is no need to go into the value in gliding of a device of this kind to provide take-off power and raise the glider to an altitude of 3000 to 5000 ft. if required. The glider is then relieved of all the limitations imposed by the use of winches or towing aircraft. Furthermore, the *Escopette* pulse-jet was designed with particular regard to its utilization at low speeds where its output and efficiency are very good, consumption being only 1.8 lb./lb.t./hr, or about twice the consumption of a good turbojet. Its simplicity of construction gives it other advantages, such as strength, light weight, low cost. Then there is the key advantage of these engines, namely low fuel injection pressures : 1 to 2 atmospheres at the most.

The *Escopettes* were mounted in two *Emouchet* SA.104 gliders belonging to the Sports and Light Flying Service, in collaboration with Engineer Jarlaud. The tests proved the value of the arrangement, and in particular the fact that the performance of the glider is relatively little affected by the presence of the stationary engines, at any rate in a glider of moderate lift/drag ratio, i.e., not designed for high performance (fig. 14). Better results would probably be obtained with an airframe designed from the outset to take pulse-jets as an auxiliary power plant. The life of the airframe does not appear to have been affected by the vibrations, as had been feared. The simple spring in the engine suspension proved its worth.

Several expert pilots, including Eric Nessler, the well-known champion, have flown these machines with full satisfaction. In addition to the simplified take-off, there was another advantage which they particularly appreciated, that of being able to re-start the engines at any time during flight. This

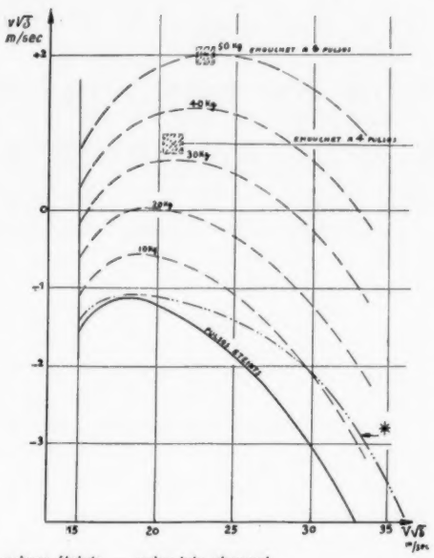


Fig. 14 : Polars of the Emouchet-Escopette *(gross weight 325 kg) for various thrusts of its pulse-jets (four or six with max. thrust of 10 kg. each). Polar of the glider without power plant is shown by dot-dash line (gross weight also 325 kg.).*

is possible thanks to the air flow. All that is necessary is to inject the fuel and provide a short series of sparks in the plug. This, for example, would enable a glider school to avoid landings in the open country and the expenses these entail.

IX. *Conclusion*

The fitting of pulse-jets to gliders is not the sole object of these experiments, which are rather aimed at making the pulse-jet into a real aircraft power plant capable of use for a variety of purposes. Considerable increases in power and efficiency have already been obtained compared with the *Escopette* fitted in the *Emouchet*, yet the margin between the present achievement and the theoretical limits is still great enough to give ample scope for improvement (200 to 300 %).

This gives us great hopes for the future of the pulse-jet, as no other form of power plant now available has such a wide development potential.

Coming Events in International Aviation

SAE	Society of Automotive Engineers — Summer Meeting	Atlantic City	June 7th to 12th
ICAO	International Civil Aviation Organization — 7th Assembly	Brighton	from June 16th (lasting about 4 weeks)
* * *	British Chamber of Commerce Exhibition " Made in England " (including aircraft)	Zurich	June 19th to 28th
DEVA	Deutsche Verkehrsausstellung (German Transport Exhibition)	Munich	June 20th to Oct. 11th
ASME	American Society of Mechanical Engineers — Semi-annual Meeting	Los Angeles	July 2nd
GfW	Gesellschaft für Weltraumforschung (German Space Research Society) — 6th Annual Meeting	Munich	June 26th to 27th
* * *	20th International Paris Air Show	Le Bourget, Paris	June 26th to July 5th (during Paris Air Show)
AFITA	Association of French Aeronautical Engineers and Technicians — International Aeronautical Congress		
AERA	Association for the Promotion of Aeronautical Research — Aeronautical Electronics Congress		(during Paris Air Show)
ICAO	International Civil Aviation Organization — 3rd Conference on North Atlantic Ocean Stations	Brighton	July 8th
IAS	Institute for the Aeronautical Sciences — Summer Meeting	Los Angeles	July 15th to 16th
WMO	World Meteorological Organization — 1st Session of Commission for Aerology ; 1st Session of Commission for Instruments and Methods of Observation	Toronto	August 10th
ICAO	International Civil Aviation Organization — Legal Committee Meeting	Rio de Janeiro	August 25th
IATA	International Air Transport Association — 9th General Meeting	Montreal	September
* * *	National Aircraft Show and 50th Anniversary of Powered Flight	Dayton	September 5th to 7th
SBAC	Society of British Aircraft Constructors — Display and Exhibition	Farnborough	September 7th to 13th
RAeS	Royal Aeronautical Society — Wilbur Wright Memorial Lecture and 4th Anglo-American Aeronautical Conference	London	September 14th to 17th
WMO	World Meteorological Organization — 1st Session of Regional Association III (South America)	Rio de Janeiro	September 15th *
SAE	Society of Automotive Engineers — National Aeronautical Meeting, Aircraft Engineering Display, and Aircraft Production Forum	Los Angeles	September 29th to October 3rd
* * *	3rd International Technical Exhibition	Turin	Sept. 30th to Oct. 11th
	5th International Plastics Congress	Turin	October 1st to 2nd
	Engineering Day	Turin	October 10th
	5th Mechanical Engineering Congress	Turin	October 9th to 11th
* * *	Beginning of England-Christchurch Race	London	October 10th
SAE	Society of Automotive Engineers — International Production Meeting	Toronto	October 29th to 30th
IATA	International Air Transport Association — Traffic Conference	Honolulu	November 1st to 22nd
SAE	Society of Automotive Engineers — National Transportation Meeting	Chicago	November 2nd to 4th
	Society of Automotive Engineers — National Fuels and Lubricants Meeting	Chicago	November 5th to 6th
IAS	Institute of the Aeronautical Sciences — 17th Wright Brothers Lectures	Washington	December 17th

* Provisional

STANDARDIZATION OF APPROACH PROCEDURES FOR MODERN RADIO AIDS

by P. CAROUR, Ingénieur de la Navigation Aérienne, Paris

THE PROBLEM

Approach procedures are today very varied ; they differ according to country, aerodrome, runway and radio aids.

This situation threatens to deteriorate still further with the introduction of new radio aids such as VOR, DME and Decca, and of civil jet aircraft, which may in some cases entail the creation of special procedures. The resulting profusion of methods complicates the work of pilots and controllers alike.

It would therefore appear to be necessary to *standardize* as soon as possible *approach procedures* at class A and B airports in particular, and if possible to define a *single procedure* to be followed by all types of aircraft.

*

Aircraft radio equipment is often a delicate problem. Cost, weight, bulk and maintenance of the various air-borne instruments do not greatly encourage the user to purchase such equipment which, more often than not, is an extra burden for him. There are many aircraft today which have no ILS receivers, and there are even some which arrive in the Paris region without equipment covering the Orly and Le Bourget approach frequencies.

It would therefore be vain to hope that all commercial aircraft might be equipped with VOR-DME for example within the near future.

Class A and B airports should be capable of *receiving any aircraft*, provided it has the following minimum equipment :

— a VHF set covering the airport frequencies,

— a radio compass,

— blind flying instruments.

Great efforts have already been made to improve the *rate of landing*, and at some airports it is already very satisfactory. *Landing rate should be constant and rapid*, whatever the aircraft's approach speeds, their direction on arrival over the reporting point and their altitudes within certain limits, of course.

No priority should be given to turboprop or turbojet aircraft on the grounds that their specific consumption is higher than that of piston-engined types.

Good traffic regulation and a rapid landing rate will make it possible to give satisfaction to all users.

Finally it is desirable that, for the purpose of training crews and ground personnel, the procedures laid down for IFR conditions should also be followed in VFR conditions.

*

The object of the present article is to propose an approach procedure which answers the above requirements.

BASIC PRINCIPLES

Standardization of procedures : Fig. 1 shows some of the differences between the systems in use today. When the reporting point (0) is not situated on axis AB (airfield with only one runway) or does not coincide with the centre of gravity of the polygon formed by the extremities of the runways (airfields with several runways), approach track from 0 to the runway will vary.

When this reporting point is situated on the airport it is possible to obtain procedures which are practically identical in flying time required, in view of the fact that pilots will not follow them with absolute precision.

If a standard system is to be evolved it is thus essential that the starting point for the approach procedure be over the airport.

*

Marking the starting point : To enable the airport to receive all aircraft with the minimum equipment defined above, point 0 must be marked first of all by a non-directional MF beacon.

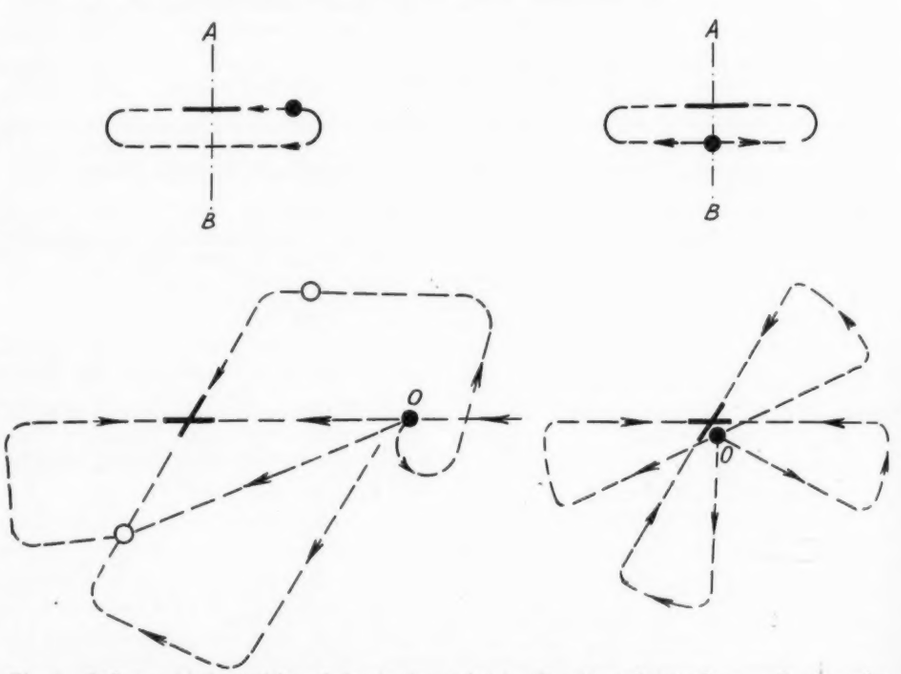


Fig. 1 : Influence of the position of the starting point for the approach procedure on the symmetry of the procedure. Left, point 0 is eccentric (Orly Airport, Paris) ; right, it lies on the perpendicular to the runway or inside the polygon formed by the runway boundaries.

In addition, in order to facilitate the approach of aircraft fitted with VOR and DME receivers, point 0 should be marked by a group comprising :

— a VOR transmitter

— a DME transmitter

— possibly a Z marker for the above-mentioned MF beacon.

*

Landing rate : Among the factors likely to reduce or disturb the landing rate are the following :

— varying speeds of approach, wind influences, lapse of time between the moment at which the aircraft should arrive at point 0 and the moment it actually does so.

— when aircraft movements are followed by radar, the track prescribed for the pilot is neither calculated nor evaluated on the scopes. This leads to an irregularity in the landing rate which even an experienced controller cannot fully compensate.

— stacking at different heights, used only for want of a better solution, reduces landing rate and leads to irregularity, in spite of its simplicity. Moreover it is not possible to distinguish between aircraft at different heights by radar, the risk of icing may be serious in certain cases, and finally, pilots find stacking tedious.

The *procedure proposed here permits of a constant rate of landing*, regardless of approach speeds and the moment of arrival over the VOR-DME-MF group. Tracks are calculated and evaluated on the radar scopes, and a rapid rate is ensured by doing away with stacking (the examples below are calculated for a landing rate of three minutes).

*

Priorities : The landing order for aircraft is based solely on their estimated time of arrival at point 0. However, if two aircraft arrive simultaneously at point 0 (three altitudes of arrival are provided for), the speed of approach should be taken as basis for priority, the fast aircraft landing before the slow one.

PROCEDURES

Three different procedures (A, B, C) have been investigated. Procedure C answers in full to the requirements, and will be described in detail. The three procedures have the following points in common : *Installation of VOR-DME-MF group at the airport :* The location chosen should be such that the required clearances (particularly for VOR) are provided, the runway safety margins satisfied and the whole procedure can be followed by radar. These problems should be capable of solution in the majority of cases. The upkeep of these aids will be facilitated by the fact that there are specialized personnel permanently on duty at the airport.

Aligning the aircraft on the QDR vector : as fig. 2 shows, aircraft arrive at point 0 from several directions and at three different altitudes, and must then line up on a magnetic course (QDR) which will be communicated to them at the proper time by air traffic control. This will be done with the aid of the directional gyro (turn-and-bank indicator and watch) by making a standard turn, i.e., at the rate of 360° in two minutes.

If the pilot has a VOR receiver, it will be easy for him to get on to the QDR vector ; if he uses only a radio compass final lining up will be assisted by instructions from control.

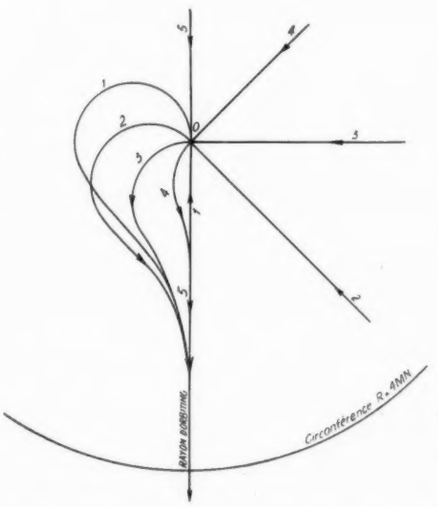


Fig. 2 : Turning on to the QDR vector using a standard turn (rate of 360° in 2 mins.)

Speeds of Approach : To facilitate discrimination only approach speeds of 120, 150 and 180 knots have been selected, but it should be stressed that the three procedures are valid no matter what the speed of approach *provided it is kept constant* from a certain distance from 0, determined by the type of procedure, *up to alignment on QFU*. The computors used are designed so that the three units, kilometres, miles and knots, can be used.

Length of track : The following track lengths have been chosen as examples :

— *thick lines* (tracks reserved for aircraft flying at 120 knots) 14 nautical miles ;

— *hatched lines* (tracks reserved for aircraft flying at 150 knots) 17.5 nautical miles ;

— *double lines* (tracks for aircraft flying at 180 knots) 21 nautical miles.

These tracks are designed to give the same flying time, i.e. *seven minutes* (with constant speed, no wind from 0 to the runway).

If the aircraft flying at 120, 150 and 180 knots were regularly spaced on crossing the vertical through 0 and made a turn of the same duration, the three circuits indicated by thick, hatched and double lines (normal tracks in unbroken lines in the drawing) would enable a constant landing rate equal to the spacing at 0 to be maintained.

These conditions are rarely all obtained at once in practice, and aircraft in the great majority of cases will follow *complementary tracks* (broken lines in the drawings).

Altitudes of arrival at group : Two or three altitudes will be selected for arrival over the vertical through point 0, as needed. Thus two or three aircraft can present themselves simultaneously at point 0, and after a standard turn on to the QDR vector, begin their approach to the runway.

*

Note : The effect of the wind on the duration of approach will be examined only for procedure C.

(To be continued)

Book Reviews

Advanced Mechanics of Materials, by Fred B. Seeley and James O. Smith (2nd Edition), published by John Wiley & Sons, Inc., New York, 1952.

This book falls into that vast category of work under the general heading of *resistance of materials*, which sets out, by mating empirical data with pure mathematics, to provide man as a constructive being with the means of domesticating nature—or coming to terms with it.

The author's ambition has been not so much to supply the technician with formulae, tables, graphs, etc. which need only be skilfully handled to provide concrete data that can immediately be applied in practice ; his ambition has been rather of an instructive nature, and the book is addressed primarily to students —provided they already have an advanced knowledge of mathematics and engineering. For the benefit of these students, whose object is to penetrate the " why " of things, the course contained here analyses the mechanical phenomena in matter when it is subjected to load—phenomena whose ultimate limit is breakdown. The problem in all practical cases arising is to remain within the breakdown limits, and the book provides all desirable solutions, after examining in detail the " why " of each of the measures taken.

As for the technician " in a spot " whose mission is to produce, using the given " recipes ", this work will give him an opportunity to return to the source, always a profitable undertaking.

La.

Météorologie Générale, by J. Roulleau and R. Trochon, Vol. I. Gauthier. — Villars, Paris. (French ; 142 pages ; price Fr. 1000).

The French public began to take notice of the essential part played by meteorology as an aid to air navigation on the occasion of the famous Atlantic flight by Costes and Bellonte, twenty-three years ago. The National Meteorological Office was then recognized officially as one of the contributors to the success of the flight and was honoured in the person of Monsieur Viaut (who today directs the collection to which this work belongs). Volume I of " Météorologie Générale " is restricted to a description of the atmosphere, an ideal static atmosphere with known dimensions and chemical composition, and with its physical phenomena, such as temperature, pressure, radiation, also clearly defined. This is a collection of essential data from all possible conditions of time and place, most of which are measurable and obey certain laws. There is as yet no discussion of the interaction of atmospheric phenomena and its influence on the present and future weather. These subjects will be dealt with in succeeding volumes, devoted to climatology, and methods of observing and forecasting the weather.

La.

The Aircraft Commander in Commercial Air Transportation, by Dr. M.S. Kamminga. — Martinus Nijhoff, The Hague 1953. (English ; 184 pages ; price Fl. 10).

For the past quarter-century CITEJA and its successor, ICAO's Legal Committee, have been working for international agreement on the aircraft commander's legal status. The longer the routes flown, the bigger the aircraft and the more numerous their occupants, the more urgent becomes the need for international recognition of the rights and duties of the person who is legally responsible for the little community temporarily shut off from the rest of the world. The work of the young jurist Kamminga clearly bears witness to its descent from the clear-thinking, cosmopolitan Dutch air law school, of which the internationally recognized works of a Professor Goedhuis are representative. The first part of the book is devoted to the position of the aircraft commander under Dutch law (but is still of interest to jurists of all nations), the second part analyses current efforts at international regulations. It would undoubtedly be an advantage if as many people as possible from civil aviation, on both theoretical and practical sides, were to read this book, preparatory to a future international agreement. He.

Les lois de l'air, by J. Lacombe and M. Saporta ; foreward by Paul de La Pradelle. — Les Editions Inter-Nationales, Paris 1953. (French ; 487 pages ; price Fr. 3000).

Editions Inter-Nationales, who publish the air law periodical, " Revue Générale de l'air ", and a large number of basic works on air law, have shown a skilful hand in this collection of the texts of laws and agreements (with brief notes). Because of the precipitate development of national and international air law, such collections are so soon out of date that a new edition is necessary roughly twice a year. The editors have been careful not to let the subject run away with them, but have limited themselves to the international agreements and French legislation that are in daily use.

He.

Le Danseur des Nuages, by Marc Augis. — ICARE, Brussels 1953. (French ; 104 pages ; Price Fr. 50).

Marc Augis, editor-in-chief of the Belgian review " ICARE ", has written in these three stories (which were preceded by a film of the same title) of acrobatic flying, war, love, marriage, etc. Entertaining reading. He

Saint-Exupéry — Le Chevalier-pilote, by Daniel Anet — Librairie Payot, Lausanne 1952. (French ; 167 pages).

It might seem almost impossible that there could be anything new to say about Saint-Exupery's life and work. Yet so much depends on the point of view. Soldiers, pilots, literary historians, scientists, have all written about this versatile Frenchman, but perhaps the poet Anet has come closest to the poet in Saint-Exupéry. He

Zwei Jungen werden Flieger (first volume in a series entitled " Gaggi der Flieger und seine Abenteuer "), by Werner Baumbach. — Blüchert-Verlag, Stuttgart 1953. (German ; 62 pages — Price DM 1.95).

The young are more critical readers than many would believe. The improbable and vague are not for them. They demand the authentic and the really new, and this is what they will find in this charming book by the well-known German pilot Werner Baumbach. He

Air Touring Guide to Europe. — Published by the Royal Aero Club Aviation Centre, London. (English ; 234 pages).

Each year this English handbook (repeatedly reviewed in INTERAVIA) gains in value to air tourists of all lands. Anyone wishing to fly in Europe will find it invaluable. He

The Aeroplane Directory of British Aviation (incorporating *Who's Who in British Aviation*), 1953 Edition. Published by Temple Press Ltd., London. 538 pages ; price 15s ; English.

This year's Directory of British Aviation reflects the continuing growth of aeronautics in the British Commonwealth, since the volume had to be enlarged from 434 to 538 pages. As usual, it contains details of British and Commonwealth aviation authorities, air forces, airlines, industries, flying clubs and some of the ground facilities and thus is a useful book for those in contact with aviation in Britain, the Dominions and Colonies. One of its most interesting features continues to be " *Who's Who in British Aviation* ", which contains about 1550 brief biographies of leading British aviation personalities.

Brennender Himmel, by Pierre Clostermann ; translation into German of French original " Feux du Ciel " ; Alfred Scherz. Berne 1952. (German ; 244 pages).

Pierre Clostermann, the well-known French flying ace, and his book " Feux du ciel "—in which he describes the deeds of both friend and foe with the same unswerving honesty—need no recommendation. The circle of his readers will be enlarged by this publication of a German translation, not reviewed here earlier for lack of space. He

Escadrille. — Published for the French Air Force by the First Air Division. Foreword by General Lechères, Commander-in-Chief, French Air Force. (French ; Price Fr. 1200).

Charity affairs in the literary or artistic field are frequently looked upon with misgivings . . . sometimes rightly so. Such feelings, however, would be out of place in regard to " Escadrille " —a historical collection of the insignia of all French Air Force squadrons from the two world wars up to the present day. Published for the benefit of war widows and orphans of the French air forces, it is divided into three " picture books " covering fighter, bomber and reconnaissance units. The emblems of the various squadrons reflect that charming irony which never forsakes the Frenchman, even in uniform. Cocks, eagles, ducks, geese, bats, dragonflies—in short anything that flies, including the devil, Hermes and the " flying " greyhound, are to be found in these colourful badges. He

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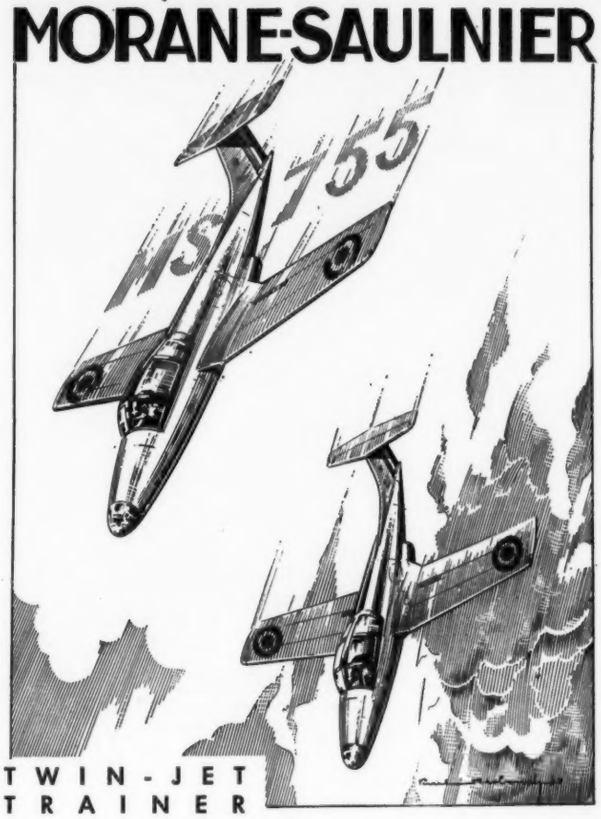

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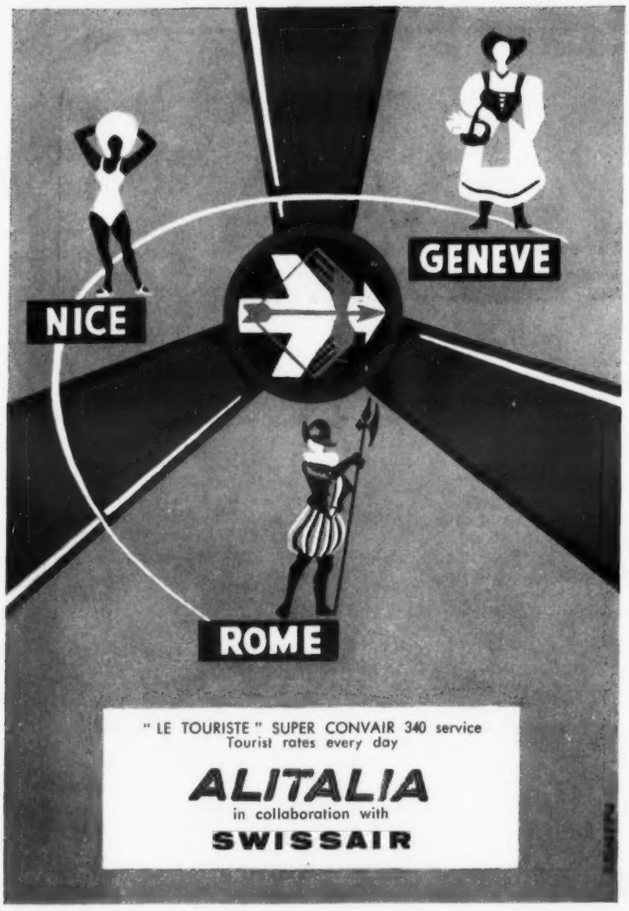

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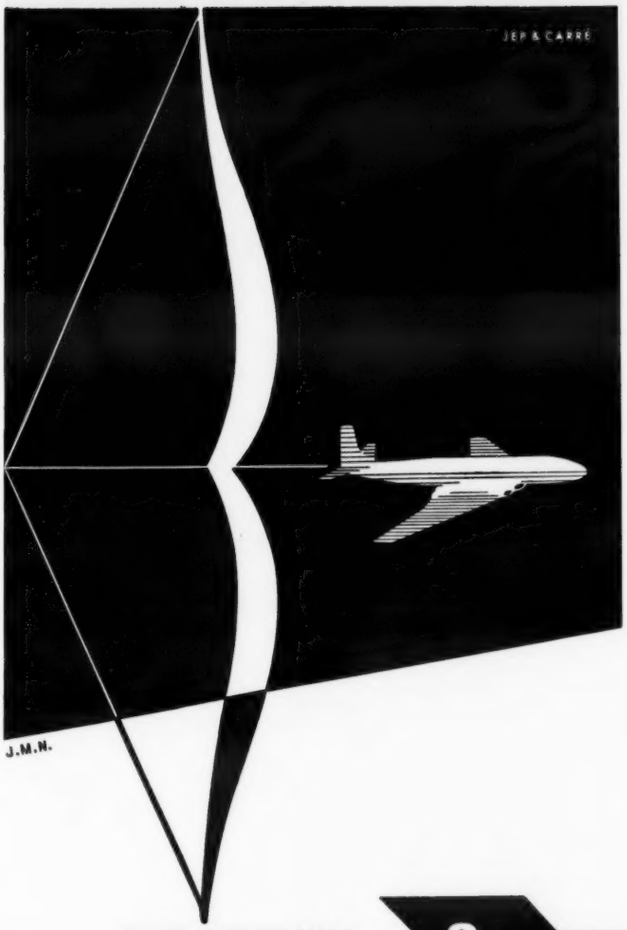

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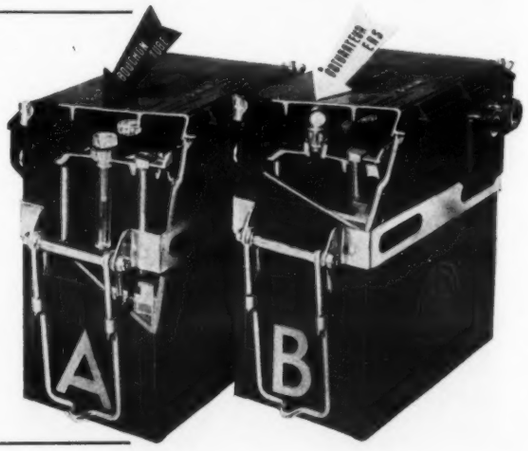

* *The white dotted area indicates the height of the plates*

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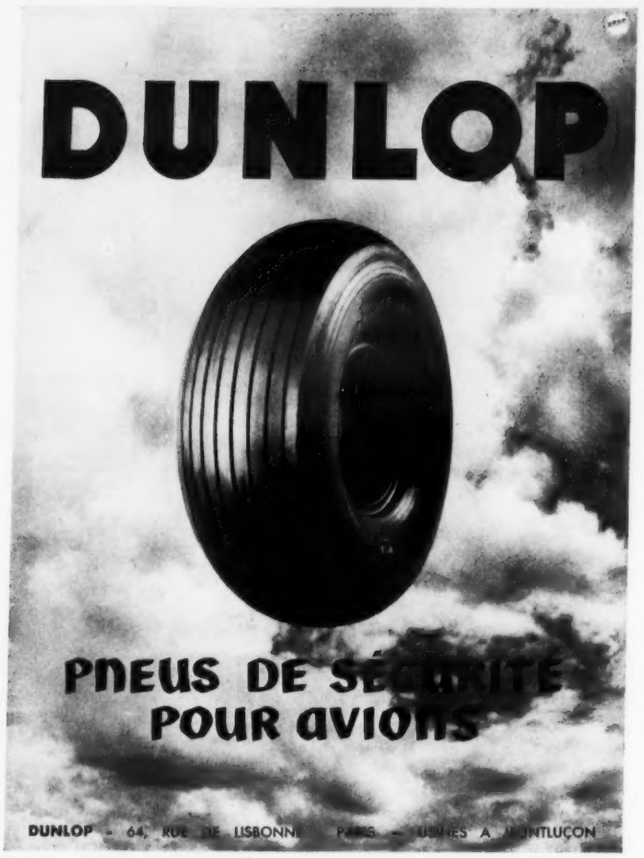

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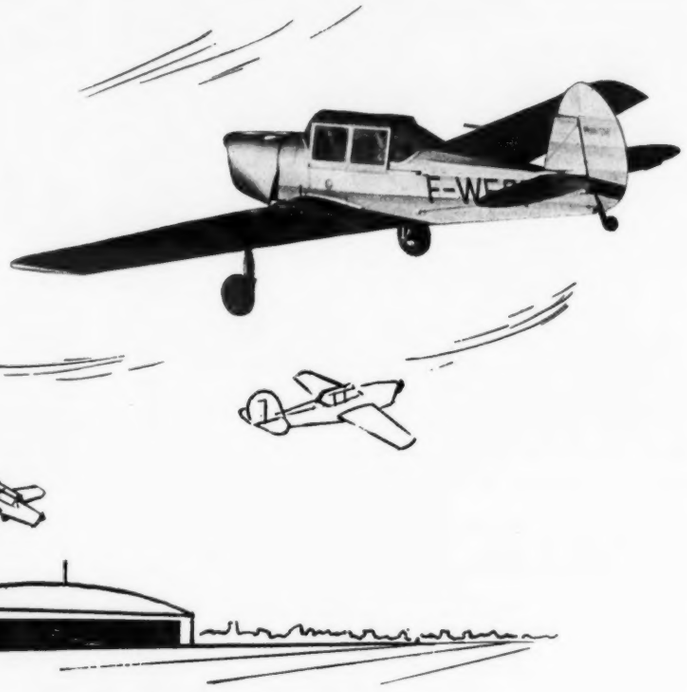

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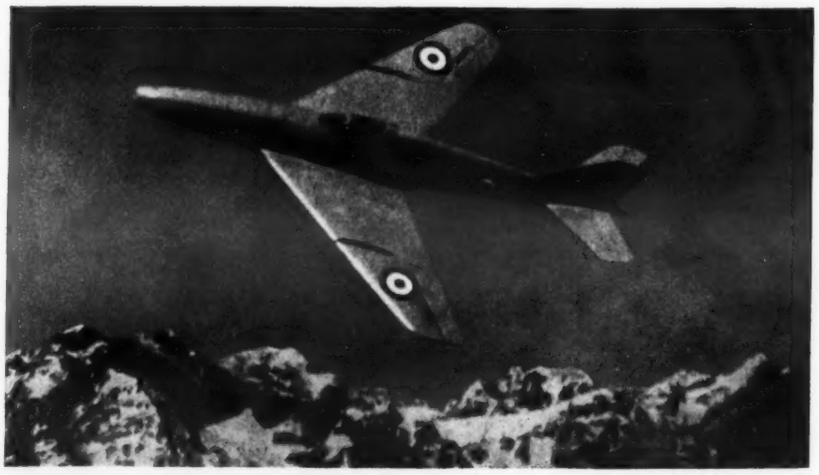

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